THE APPEARANCE OF MODERATION, CREDIT MARKET DISCRIMINATION, LITERACY TRAPS, AND A NOTE ON PRODUCT BOYCOTTS

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John William Gray

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FOUR ESSAYS: THE APPEARANCE OF MODERATION, CREDIT MARKET DISCRIMINATION, LITERACY TRAPS, AND A NOTE ON PRODUCT BOYCOTTS

John William Gray, Ph.D.

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There has been a progression in the field of economics from modeling the individual as an atomistic entity, to one born with a social identity. This dissertation is a collection of four chapters that examine how the individual's social environment constrains choice and institutions can play a role in overcoming these constraints. To approach this line of economics topics are explored from ethnic conflict and cooperation, discrimination, literacy traps and the ambiguous effect of consumer activism.

The first chapter models the individual's choice of culture as a way to modify her innate identity. Culture norms are shown to impact the level and stability of cooperation that is attainable in two otherwise uncooperative social groups. The chapter demonstrates that even when individuals are given a choice to shed unproductive characteristics the option may not be chosen. The implication is that individuals of one social identity may be trapped in a Pareto inferior equilibrium. It is shown that coordination from an outside party is may be necessary for social change. The model also demonstrates how the incentives of the various identities may conflict leading to social norms that discourage progressive change among individuals of various groups.

The second chapter is an empirical test for taste based discrimination in small firm access to US credit markets. It uses the Federal Reserve Bank's Survey of Small Business Finances. One unique element of the chapter is that it explicitly controls for the possibility that loan officers statistically discriminate. Previous tests did not allow

for statistical discrimination and thus suffered omitted various bias. Additionally this chapter explores the possibility of selection bias. Evidence of both types of discrimination are documented and when selection bias is controlled for, evidence of taste based discrimination increased.

The third chapter, jointly written with Atal, V., Basu, K. and Lee, T. demonstrates the possibility for a community to get caught with a low level of literacy trap. Individuals in the community do not find it worthwhile to invest in skills because others in the community do not have skills. The model demonstrates the importance of institutions and policy that can solve the coordination problem in the individual's education strategy.

The fourth chapter presents a model in which consumer activism impacts the price of using child labor. By incorporating social externalities, the impact of consumer activism on child labor becomes ambiguous.

BIOGRAPHICAL SKETCH

John William Gray, son of Dr. Belinda Tilley and Pastor William A. Gray III, was born July 31, 1983, in Baltimore, Maryland. He graduated from Randallstown High School in 2000. He attended American University in Washington, D.C. and graduated with a Bachelor of Arts in Economics and Philosophy in 2003. He then entered graduate school at Cornell University in 2003.

To God, family, the economic dept staff and You who gave strong arms of support during my shakiest times.

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Ind98	=1 if the firm is in 1998 survey
no_own_de1	=1 if the firm's owner has no delinquencies
no_firm_de1	=1 if the firm has no delinquencies
no_judgments	=1 if the firm has no judgments against it
lowrisk	=1 if the firm has rating greater than 76 by Dun and Bradstreet
home_own	=1 if the firm owner owns a home
educ	=1 if the firm owner has more than a GED
banktype	=1 if the firm applied for a loan at a commercial bank
fam	=1 if the firm is family owned
global	=1 if the firm sells globally
lnsales	=log(sales)
lnprofit	=log(profit)
lnliabilities	=log(liabilities)
lnassets	=log(assets)
lnloansiz	=log(loan size)
siz1	=1 if the firm has less than 10 employees
siz4	=1 if the firm has more than 400 employees
ssic3-7	=1 if the firm's produce is classified under the corresponding ssic code.
hh1	=1 if the firm is in a competitive region
lnexper	=log(experience)
lnfirmag	=log(firm age)
female	=1 if the firm owner is a female

Chapter 1

The Appearance of Moderation:

The Economics of Choosing Individual Identity

Introduction

How do social markers become politicized enough to mobilize populations to war? What forces create a world where Yugoslavians become warring Serbians and Croatians; a Danish cartoon has the power to spark riots and brutal killings worldwide? Nigeria has lost hundreds of people as competing sides defend the sanctity of their God. Not to mention Rwandan. With the death and destruction caused by racial, ethnic and religious polarization, mutual cooperation clearly seems preferable to these flares of reality. This paper explores an instance where the adoption of a norm, can build trust. It also shows how costly and fragile that trust can be.

Although sociologists and anthropologists have a tradition of studying the individual in relation to her society its place in economics has until recently been sparse. There was a profound impact on the economic profession with Akerlof and Kranton's (2000) "Economics and Identity" which placed considerations of identity into the individual's preferences. Subsequently, Basu (2005) and Sen (2006) brought attention to the venomous and divisive potential of identity when the behavior of an individual is attributed to all individuals of her social group. While Sen's focus is on the multiple identities a person might associate with and the conflict that can arise as a result, Basu shows how a small minority of extremists can cause conflict between two otherwise peaceful groups. In closely related work, Darity, Mason and Stewart (2006) use an evolutionary game-theoretic framework to model the persistence of racialized identities. While their focus is not on resolving conflict between two competing groups, their work gives insight into some of the conditions that make for a more polarized society. In addition to the theoretical literature, empirical research by those

such as Hoff and Pande (2006) has engaged in projects to quantify the cost of social stigma.

The early economic works on identity treat a person's social identity as a parameter in her utility function, i.e. a constant an individual is either lucky or unlucky enough to be born with. Of course, much of how an individual is seen by the world is impacted by her choices. Although the individual is constrained by the outside world, it is a dramatic simplification to model her as having no choice in her social identity. Fryer and Jackson (2003) attempt to overcome this shortfall in previous works by giving the individual this choice. In an adaptation of a signaling model in the spirit of Akerlof (1970), Arrow (1971), and Spence (1973) the individual shapes how society views her by her investments in social and productive capital. As a result Fryer and Jackson (2003) provide insight into social pressures for individuals to perform unproductive activities. Although Fryer and Jackson (2003) has results consistent with some otherwise puzzling empirical realities, its modeling of the individual's choice is not completely satisfactory as it assumes the presence of a peer-group that cares neither about its member's productive ability nor well-being. A peer group, however, is made of a collection of individuals, all of whom care about their own well-being. To model the impact of a social identity on an individual, the preferences of the individuals in the society, both in and out of the peer group, should shape the preferences of the peer-group. The most striking results of Fryer and Jackson (2003) break down when the peer-group desires its members to be productive elements of society.

From middle class Blacks in the United States who Wilson (1980) wrote, made "a conspicuous effort to disassociate themselves from the black masses" (p. 21) to lower caste groups in India, for example the Namasudra that Banjeree-Dube (2008) wrote, "constructed a collective self-image radically different" from the historical

view, history has provided examples of individuals and groups of individuals making proactive choices with the hope of changing their social position. To model the peer-group's preferences as fixed and independent of the group members' preferences precludes such choices. Indeed, excluding these changes precludes individual rationality. When an individual is assigned a social identity that results in an inferior social status and a low well-being the economist should examine the incentive an individual has to change society's perceptions and the constraints on this choice. It is on this bilateral relationship between the individual and her social identity that this model focuses. Although a social identity shapes the individual, the social identity exists only as a collection of individuals and the objectives of a peer-group depend on the preferences of its members. Thus the goal of this paper is to continue a progression in the economics literature from the atomistic individual, to the individual born into and with a social identity, to an individual with some choice, however constrained, in shaping how society views her.

The individual's choice is the focus of this paper; although to conceive of it as completely free and costless would be naive. Indeed, moving against mainstream attitudes, actions, and beliefs can have very uncomfortable results. Examples abound in the anthropological literature. In studying Muslim and Christian relationships in the Philippines, Lacar (1980) estimated that as recently as 1980, only 12-18% of parents agreed with such a marriage and 78% of parents were kept in the dark about such courtships. Finally, he notes a "dropping out" of religion by the inter-religious couples, which he supposes is caused by an avoidance of conflict which suggests that there is a cost of cooperating with those of the other culture.

Sociological and anthropological literature also suggests that in polarized societies, teaching stereotypes about hostile groups and the indoctrination of fear is common practice. Lacar (1980) documents such child-rearing practices and provides

evidence of children who are proficient in identifying others as members of a visual group. In the Philippines in the 1980's, Lacar (1980) notes, Christian children were taught to use the derogatory "Moro" to describe their Muslim counterparts while Muslim parents whisper "land grabber" to their children behind their Christian neighbors' backs. Similarly, Bar-tal (1996) observes that Israeli children as young as eight use visible cultural traits, such as style of dress and language, to distinguish good and friendly Arabs from the bad Arabs that that kill Jews.

Another cost is revealed by Brewer and Campbell (1976) who offer a compelling survey of East African cultural attitudes. Their work describes how colonialism brought together groups who were previously isolated and eventually defined them in ethnic blocs determined by the stereotypes attributed to those groups. One particular stereotype noted in the survey is the "thriftlessness" of the Luo. It is difficult to imagine the "thrifty" Kikuyu embarking on a business venture with such wasteful people. When evaluating a business venture with a Luo, a Kikuyu who believes in this stereotype will factor in this cost even if this stereotype does not fit the particular Luo. In parallel, a Luo might over exert his energies trying to overcome this stereotype in meetings with a Kikuyu. In both cases cooperation across ethnic groups comes at a greater cost than within ethnic groups.

Basu (2005) suggests that a key to overcoming these prohibitive costs is recognizing the fallacy of such stereotypes and attributing historical actions to those who committed them as opposed to attributing them to a whole group. If this ideal could only be achieved the cost to cooperating with other groups would be greatly diminished and the cooperative equilibrium would be possible. This model presupposes that this identity-blind world does not exist. To overcome a lack of cooperation individuals must join groups, i.e. choose a culture, and for each set of norms, strategies, the possible increase in inter-ethnic cooperation is explored.

There is a long literature of institutional, group, and norm formation in economics. Greif, Milgrom, and Weingast (1995) present evidence that when 11th century merchants formed groups such as the "Maghribi traders" trade in North Africa doubled. The evidence relating group formation to productivity is however far from one-sided. In 1574 Elizabeth I enacted sumptuary laws that restricted the dress of the poor "so that differences of estate may be known by their apparel". Apparently the group of well dressed people in the population had become too large for membership in the group to be a credible signal of membership in a particular status. As a result the Queen restricted group membership. In 1691 North (1691) commented that the law had reduced the industry and ingenuity of England. The Queen was concerned about the stability of a signaling status of a style of clothing and thus restricted group membership. North had less issue with informational concerns and instead addressed the effect the Queen's order had on the population's incentives to engage in enterprise.

In this and a companion paper Gray (2009) explore the trade-off between stability and inter-ethnic cooperation when the purpose of signaling is to increase inter-ethnic cooperation. The two papers demonstrate that 1) signaling, i.e. group formation, can be an effective means of inter-ethnic cooperation, 2) for the highest amount of inter-ethnic cooperation groups must be exclusive in that they do not cooperate with non-group members, 3) when groups are non-exclusive the equilibria with the highest level of cooperation are unstable and inter-ethnic cooperation can be unstable.

Model

Following Basu (2005), society has a set, S, of individuals. Each individual has two characteristics. For person $i \in S$, $e_i \in \{A, J\}$ is her innate, visible characteristic; for example, her ethnicity. Her second characteristic is private. It captures a cost that she incurs when she cooperates with individuals of a different visible identity. These

costs may be associated with stereotypes and prejudices she holds against the other group's members, but they may also be the result of physical impediments such as the costs of communicating across the different languages and customs of each ethnicity. A person $i \in S$, with visible type e_i has invisible characteristic $c_i \in [0, \bar{c}_{e_i}]$ and is summarized by the ordered pair (e_i, c_i).

Community engagement is modeled as a random matching game. One could imagine the players deciding whether or not they should build a community school, form a worker's union, or engage in a cooperative business venture. In their meeting they can choose to be cooperative and play C, or to take a more aggressive stance in their meeting and play A. As individuals are matched in pairs and each has two possible actions there are four possible outcomes to a match. The monetary payoffs to each possible match are described in Table 1-A. The outcomes are such that the literature describes the game as an Assurance Game. It is one of trust. Table 1-A describes the situation of two people working together on a project where each person hopes for a cooperative outcome. As long as there is mutual trust between the players a high payoff equilibrium with each person working cooperatively will be reached. The less optimistic result is one where a lack of believable assurances leads to the Pareto-inferior aggressive equilibrium where each individual chooses to play A.

Table 1-A

i\j	C	D
C	10, 10	1, 8
D	8, 1	2, 2

Society is modeled so that individuals of the same ethnicity have the necessary networks of family and friends to maintain the trust needed to reach the cooperative equilibrium in meetings among each other. In meetings across ethnicity, the game is

different. When people of different ethnicities are matched, the benefit to cooperation is lower for each individual *i* by the amount c_i. The payoffs to inter-ethnic meetings are in Table 1-B. Neither person knows the other's cost of cooperation. They might only form expectation of the cost based on the known distribution of cost for each ethnicity. When $\bar{c}_e > 2$ for $e_i \in \{A, J\}$ there are some people, "extremist", in the society that never want to cooperate across ethnic groups. It is the possibility of being matched with an extremist that causes inter-ethnic cooperation to break down in this model.

Table 1-B

i\j	C	D
C	10-c_i , 10-c_j	1-c_i , 8
D	8 , 1-c_j	2 , 2

An individual has many visible characteristics. One's ethnicity falls into the small category of innate and fixed features. Others, such as level of education (visible from the enunciation and usage of certain words or from the degrees from an office wall), style of dress, or membership to a business or political organization are subject to individual choice. In all of these spheres an individual might find it worthwhile to adopt such features in order to be identified by another group, in this case the other ethnicity, as an individual with low cost of cooperation. Here we present an extension of the Basu (2005) framework that focuses on the individual's choice of a particular visual characteristic, her culture, and explore the conditions in which as a result inter-ethnic cooperation may be reached.

We introduce a period 0, before the random matching games, where individuals augment their visible ethnicity by choosing a culture. We assume they

have a binary choice of a visible trait $t \in \{F, M\}$. After choosing t, individuals are matched and the human interaction game commences. Before, there were two types of matches that could occur. Individuals could be matched with someone of their own ethnicity and cooperate costlessly, or be matched with someone of a different ethnicity and not cooperate due to uncertainty over the other's cost of cooperation. With the pre-game choice there are four visibly distinct types an individual might be matched with, {M, A}, {F, A}, {M, J} and {T, J}, and in each case expectation over the cost of cooperation can be based on both e and t.

In Basu (2005), individuals experience a cost to cooperate across ethnicity. This cost might be explained by historical conflict and prejudice. If individuals of one cultural type benefit from cooperating across ethnicity, others might try to mimic that culture in the hope of benefiting from inter-ethnic cooperation. This suggests an important way an individual is constrained in her choice of identity. The larger the share of individuals choosing the 'moderate' or 'cooperative' culture the higher are their average costs to cooperating. At some point it becomes irrational to believe that individuals choosing the cooperative culture will actually cooperate across ethnicity. Although there is freedom of choice in culture, how the culture will be perceived by others is out of the individual's control.

As modeled, implicit in creating a new identity to overcome inter-ethnic polarization is the creation of intra-ethnic hostility. We assume this is the result of the same type of prejudice and stereotypes that impacts the cost of cooperating across ethnic types. There are situations in which this assumption may be extreme, i.e. ethnic networks cross cultural lines, but in many other cases the assumption might be too weak, i.e. those of a different culture are seen as traitors who openly conspire with a foe and are thus hated more than those afflicted by nature to be the enemy. To simplify the analysis we look at the case when the cost an individual has cooperating

with someone of a different culture is the same as the cost of cooperating with someone of a different ethnicity. Thus, if two individuals, i and j, are matched, the payoffs to their actions is given by Table 1-A if $(t_i, e_i) = (t_j, e_j)$ and their payoffs are given by Table 1-B otherwise.

At this point it is helpful to clarify this paper's innovation in how social identity and peer-groups impact an individual's choice of culture. Individuals are not born with a preference for a certain group or type of people. They are born with an ethnicity and a cost for cooperating with anyone visibly, in culture or ethnicity, different. By her choice of culture, the individual has some control of who she is and when and where these costs occur. It should also be noted that for the cases considered, regardless of the meeting type both individuals cooperating Pareto dominated neither individual cooperating. As a result, unlike Fryer and Jackson (2003) the models results are not driven by a choice between social prowess and productivity. The model's results are driven by the individual's inability to separate the actions of one individual from those of the group. Low cost individuals hope to choose a culture that is identified with a willingness to cooperate with those expected to cooperate. This hope is constrained by the actions of other individuals and the resulting beliefs individuals have on the distribution of cost in each culture.

A Moderate Sub-Culture with No Dominant Ethnicity

In order for behavior strategies to constitute a Bayes-Nash equilibrium each individual must act in accordance with the best strategy given the strategy of the other individuals. Let Δ_e: $(\mathrm{F}_e, \mathrm{F}_{e_i}), (\mathrm{F}_e, \mathrm{M}_{e_i}), (\mathrm{M}_e, \mathrm{F}_{e_i}), (\mathrm{M}_e, \mathrm{M}_{e_i})$ and $\Lambda \equiv \Delta_{\mathrm{A}} \cup \Delta_{\mathrm{J}}$ be the possible matches in the interaction game. A strategy σ: $\in [0, \bar{c}_{e_i}] \times \Lambda \rightarrow \{\mathrm{C}, \mathrm{A}\}$ maps an action to each possible meeting. In period 0 the individual chooses the culture and strategy that yields the highest expected payoff given the strategies of everyone else. As a result of the random matching framework of the model, incredible threats are not

possible, i.e. in equilibrium no individuals use dominated strategies and the set of Bayes-Nash equilibria is the set of sequential equilibria. In deciding which culture to choose an individual only needs to compare the expected payoff of playing the highest paying strategy for an M to the expected payoff to the highest paying strategy for an F given the other players strategies. In this sense, each individual chooses her optimal culture.

The particular focus is on pure strategy Bayes-Nash equilibrium in which individuals choosing M always cooperate with others choosing M. If this is the case, in equilibrium, person i's expected payoff to choosing the moderate culture is decreasing in her idiosyncratic costc_i. Since the moderate signal is not meaningful if everyone chooses to be moderate, then equilibrium with inter-ethnic cooperation must involve an interior solution. Such an equilibrium involves a pair of thresholds (c^*_J, c^*_A), such that an individual (x_i, c_i) with cost less than her respective threshold. i.e., $c_i < c^*_x$, best responds by choosing the moderate cultural trait and cooperating in meetings with other M's

Let Θ be the share of A in the community so that 1-Θ of the community is J. To keep the model as simple as possible we assume that the matching probabilities are determined by the population shares and are equal across ethnicities. Let $F_e(c)$ be the fraction of individuals with ethnicity e that have idiosyncratic cost $c_i \leq c$.

ASSUMPTION 1 $F_e(c) = U[0, c_e]$ for $e \in \{\text{J}, \text{A}\}$ and $2 < c_e < 8$ for $e \in \{\text{A}, \text{J}\}$

The costs are distributed uniformly across the population to simplify the analysis. That $\bar{c}_e > 2$ ensures there are extremist in the population, those that would benefit from aggressive play against cooperative players, but $\bar{c}_e < 8$ ensures the (C, C) equilibrium Pareto dominates the (A, A) equilibrium in all matches.

PROPOSITION 1: *Given Assumption 1, there is no pure strategy Bayes-Nash equilibrium where everyone with cost less than two, takes on the 'cooperative' culture, M, and in equilibrium best responds by cooperating across culture and ethnicity.*

PROOF: The proposition considers the case where all non-extremist take to one culture. This could happen in two ways. If everyone, extremist or not, chooses the same culture then of course there is no cross culture cooperation. In the second possibility society has one cooperative and one extremist culture. It is clear that in inter-cultural meetings members of the extremist culture never cooperate. Knowing this, individuals of neither group cooperate in inter-cultural meetings. In neither case is their inter-ethnic and inter-cultural cooperation when all non extremist take the cooperative culture.■

Proposition 1 demonstrates that implicit in this model is that overcoming inter-ethnic conflict requires the creation of intra-ethnic division. In what follows we explore one type of equilibrium that demonstrates this tension.

PROPOSITION 2: *If* $1/3 < \Theta < 2/3$*, i.e., neither ethnicity has an overwhelming majority, there is a pure strategy Bayes-Nash equilibrium with across-ethnicity cooperation. Individuals with ethnicity e and cost less than* c_e *will choose the cultural type* M*. Those that choose cultural type* M *will cooperate regardless of ethnicity. Individuals not choosing* M *will only cooperate with individuals of the same ethnicity and culture. If* θ_e *is the share of ethnicity* $e \in \{A, J\}$*choosing the modern culture, then i)* $0 < \theta_e < 1/2$*, ii)* θ_e *is increasing or decreasing in her ethnicity's share of the total population, and iii)* θ_e *is decreasing in* $\bar{c}_A$ *and* $\bar{c}_J$*.*

PROOF: In an equilibrium where moderates only cooperate with moderates, if person i has $x_i = \mathrm{A}$, she is willing to choose the moderate cultural trait if and only if

$$F1\left(\theta_A, \theta_J, c_i\right) = 8(-1 + 2\theta_A)\Theta + (1 - \Theta)(8 - \mathrm{c}_i)\theta_J \geq 0 \qquad [1]$$

When $x_k = J$, person k is willing to cooperate if and only if

$$F2(\theta_A, \theta_J, c_k) = 8(-1 + 2\theta_J)(1 - \Theta) + \Theta(8 - c_k)\theta_A \geq 0 \qquad [2]$$

At interior thresholds $\hat{c}_A = \theta_A \bar{c}_A$ and $\hat{c}_J = \theta_J \bar{c}_J$ equations [1] and [2] hold with strict inequality. When the A's are best responding, the share choosing the moderate cultural trait is

$$\grave{\theta}_A(\Theta, \theta_J, \bar{c}_A) = \frac{8(\Theta - (1-\Theta)\theta_J)}{16\Theta - \theta_J \bar{c}_A(1-\Theta)} \qquad [3]$$

and the inverse of the share of A choosing the moderate culture is

$$\acute{\theta}_J = F^{-1}[\grave{\theta}_A(\Theta, \theta_J, \bar{c}_A) = \frac{8\Theta(1-2\theta_A)}{(1-\Theta)(8-\theta_A \bar{c}_A)} \qquad [4]$$

When the J's are best responding, the share choosing the moderate culture is

$$\grave{\theta}_J(\Theta, \theta_A, \bar{c}_A) = \frac{8(1-\Theta-\Theta\theta_A)}{16(1-\Theta)-\theta_A \bar{c}_J \Theta} \qquad [5]$$

The inverse of the share of J's choosing the moderate culture is

$$\acute{\theta} = F^{-1}[\grave{\theta}_J(\Theta, \theta_A, \bar{c}_A)] = \frac{8(1-\Theta)(1-2\theta_J)}{\Theta(8-\theta_J \bar{c}_J)} \qquad [6]$$

Equilibrium occurs at $\theta_J{}^* \in (0,1)$ such that $\grave{\theta}_A(\Theta, \theta_J, \bar{c}_A) = \acute{\theta}_A(\Theta, \theta_J, \bar{c}_J) = \theta_A{}^* \in (0,1)$. Equations [1] and [2] imply part i) of the proposition. As individual cost are strictly less than 8, i.e. $c_e < 8$ for $e \in \{A, J\}$ these equations are strictly positive for $\theta_e \geq 1/2$. After noting that $\partial\acute{\theta}_A/\partial\theta_J < 0$, $\partial\grave{\theta}_A/\partial\theta_J < 0$, and $\partial\acute{\theta}_A/\partial\theta_J < \partial\grave{\theta}_A/\partial\theta_J$ for $0 < \theta_J < \min\{\Theta/(1-\Theta), 1/2\}$ it is clear that if there is a θ_J such that $\acute{\theta}_A = \grave{\theta}_A$ it is unique in the relevant range. Also note that $\acute{\theta}_A(\Theta, 0, \bar{c}_J) = \Theta/(1-\Theta)$ and $\acute{\theta}_A(\Theta, 1/2, \bar{c}_J) = 1/2$ while $\grave{\theta}_A(\Theta, 0, \bar{c}_J) = 1/2$ and $\grave{\theta}_A(\Theta, 1/2, \bar{c}_J) = (1-\Theta)/\Theta$, with $\partial\acute{\theta}_A/\partial\theta_J < \partial\grave{\theta}_A/\partial\theta_J$ implies for equilibrium $= (1-\Theta)/\Theta < 1/2 < \Theta/(1-\Theta)$ which implies $1/3 < \Theta < 2/3$

To prove parts ii) and iii) note the equilibrium shares are $\theta_A{}^*$and $\theta_J{}^*$. The envelope theorem gives

$$\frac{\partial \theta_A{}^*}{\partial v}\Big|_{\theta_A{}^*, \theta_J{}^*, \bar{c}_A} = \frac{\frac{\partial F1}{\partial v}\frac{\partial F2}{\partial \theta_J} - \frac{\partial F1}{\partial \theta_J}\frac{\partial F2}{\partial v}}{-\sqrt{d}} \qquad [7]$$

and

$$\frac{\partial \theta_J^*}{\partial v}\Big|_{\theta_A^*,\theta_J^*,\bar{c}_J} = \frac{\frac{\partial F1 \partial F2}{\partial v \, \partial \theta_J} - \frac{\partial F1 \partial F2}{\partial \theta_J \, \partial v}}{-\sqrt{d}} \qquad [8]$$

Parts ii) and iii) are direct implications of equation [7]. A graphical proof can be found in Gray (2009).■

The parameters of the model are such that mutual cooperation is always Pareto superior to mutual aggression. Basu (2005) has demonstrated how the fear mongering and prejudice of a few extreme individuals can ignite hostilities between people. When the politicized trait divides the population evenly, the stereotypes are extremely difficult to overcome. Inter-ethnic cooperation comes at the expense of division within each ethnic group. Families are divided as individuals choose between a fear bread fundamentalism and modern way of life.

The model suggests that when there are hostilities between approximately equally sized ethnic groups, demographic changes have a dramatic impact on the type of cooperation between individuals of the competing populations. As a group loses its power in numbers, a larger share of its members may choose the traditional culture, isolating themselves from both the other ethnic group and the now smaller share of individuals of their ethnicity that choose the modern culture. As a result, individuals that choose the modern culture are more isolated from individuals of their own ethnic group. Consider the impact the influx of freed slaves had on racial tension in northern cities in America in the late 19th century. Wilson (1980) documents, "prior to 1900, one would rarely find a solidly black block, and a significant number of Negroes lived in white neighborhoods...White churches, which had allowed small numbers of blacks to participate in their services in the 1870s and 1880s, attempted to ease out black members altogether" (p. 64). Wilson reports that it was during this same period that the black population in northern cities increased from 58.9% in Philadelphia to 148.2% in Chicago. In some cases competition in the labor market was sure to have

affected the hostility between the groups but the model suggest that the drastic changes in population shares would have been enough to disturb the harmony and have a noticeable impact on the equilibrium attitudes each groups individual's would share towards the others.

The third part of the proposition demonstrates a reason for optimism. A decrease in the hostility one ethnicity has towards the other results in a higher share of both groups choosing the moderate culture. In this equilibrium reducing the cost of cooperation is the first step to achieving higher levels of cooperation. Further analysis in Gray (2009) shows that a decrease in the cost of one group increases the share of cooperators for both groups only if the economy is in a stable equilibrium. Gray (2009) also shows that only when moderates ban cooperation with non fundamentalist of their own ethnicity can stability of equilibrium be guaranteed. Gray (2009) also suggest a test for equilibrium stability that involves looking at the effect of a decrease in one groups cost on the equilibrium share of signalers.

Jibrin Ibrahim's (1991) study of religion and politics in Nigeria is illustrative of this type of equilibrium. He writes, "[Colonialism] has led to the evolution of political strains and conflicts between Nigerian proponents of the two rival universal religions that the Middle East has offered to the world" (Ibrahmi, 1991). With Muslims dominating the north and Christians the south, the country as a whole is divided almost evenly. Cooperation between members of the two groups is tenuous at best. Griswold (2008) wrote an article entitled "God's Country" published in the March 2008 issue of The Atlantic that describes the start of the chaos that erupted after a Danish cartoon was published that was offensive to Islam. Many things happened but no one knew the individual perpetrators of the actions. A Muslim lawyer said, "Someone shouted arna-infidel. Someone spat the word jihad...Someone picked up a stone" (Griswold, 2008). And so riots and killings ensued. Cooperation between

groups was forbidden. Christian girls were not to be seen with Muslim boys. Individuals suffered a penalty for trying to cooperate across groups. The article reports that as the killing increased two leaders of the fighting, an imam and a pastor, changed their message to one of moderation and cooperation. As they teamed up to preach a message of peace their former compatriots now describe them as sellouts.

In his treatise on the historical development of caste in India, Dirks (1980) provides additional anecdotal evidence that groups with decreasing hostility have increased willingness to cooperate across ethnic groups. In what began as a fight against Brahmin privilege Dirk notes the irony in "that the very upper-caste non-Brahman groups who contested Brahman privilege were the ones who sought to keep the depressed classes in their ritual position of inferiority and subservience" (p. 241). The initial flair over contested privilege caused upper-caste non-Brahman's that had normally chosen our models M, to join the fight with the depressed Fs against the Brahman cause.

Other Types of Cooperative Equilibrium

The above discussion has shown that inter-ethnic cooperation requires intra-ethnic division and that one type of inter-ethnic cooperation is possible given no ethnic group has an overwhelming share of the total population. The equilibrium described has moderates completely isolated from others in their ethnic group. Fortunately, in the midst of conflict there are pockets, large and small, of inter-cultural and inter-ethnic cooperation across the world. It is this type of situation that is described in the next section. Specifically, we explore an equilibrium in which one ethnicity is divided while the other ethnicity engages in cooperation across cultural types.

Consider an equilibrium where individuals of ethnicity A continue to play the strategy described in the previous section. Thus, an A with $c_i < \hat{c}_A$ are moderates and cooperate only with other moderates. An A with $c_i \geq 2$ are fundamentalist and only

cooperate with another fundamentalist A. Consider a strategy where the cultural norms of individuals of ethnicity J are different. The moderates there engage in cooperation across ethnicity regardless of culture. Thus a J with cost $c_i<\hat{c}_J < 2$ chooses the moderate culture and engages in inter-cultural and inter-ethnic cooperation, i.e. they cooperate with other J's regardless of culture and A's that choose M. An individual J with cost $\hat{c}_J < c_i < 2$ chooses to be (weak) fundamentalist and cooperates in meetings with anyone from her ethnicity and does not cooperate otherwise. Finally, an individual J with $c_i > 2$ chooses the fundamentalist culture and cooperate only in meetings with fundamentalist of her. A's are best responding in their human interaction game as long as the cutoff cost is less than 2. The constraints on J's are more complicated. It is clear that moderates cooperating with moderates, fundamentalist cooperating with fundamentalist of the same ethnicity and fundamentalist with $c_i < 2$ cooperating with moderates of the same ethnicity are best responses given the above strategies. For moderates to cooperate with fundamentalist of their own ethnicity they must have a high enough expectation of cooperation in return. As individuals with $c_i > 2$ never best respond by cooperating across culture or ethnicity there need to be enough weak fundamentalist. An immediate result is that for this strategy to be optimal in equilibrium there must be individuals that prefer cooperation with cooperators that nevertheless choose the 'non-cooperative' culture. An individual i's best response in a meeting with individual j is cooperation if and only if $c_i - 1$ where p is the probability j will cooperate. If two J's a moderate, i, who fully cooperates with a fundamentalist, j, the probability j will cooperate in return is $(2 - \hat{c}_J)/(\bar{c}_J - \hat{c}_J)$. Thus a J that chooses the moderate culture best responds by cooperating only if $2>(6 - \bar{c}_J)/2 > \hat{c}_J$ where $\hat{c}_J$is the threshold. For equilibrium, equation [1] must equal zero at $c_i = \hat{c}_A$. For J's to separate in equilibrium, an individual i with $c_i = \hat{c}_J < 2$ must be indifferent between being an M and cooperating

with M's and F's of her own ethnicity and choosing F and only cooperating with F's of her own ethnicity. If $\nu = (1-\Theta)/\Theta$, this is true for J's when

$$F3\left(\theta_A, \theta_J, c_k\right) = \frac{18-\bar{c}_A(9+c_k(1-2\theta_A)+(-8+c_k)\nu\theta_J)}{\bar{c}_A(1+\nu)} \geq 0 \quad [8]$$

In equilibrium both equation [1] and [8] must equal zero. Solving both equations for θ_A gives

$$\grave{\theta}_A\left(\Theta, \theta_J, \bar{c}_A\right) = \frac{8(1-\nu\theta_J)}{16-\theta_J\bar{c}_A\nu} \quad [9]$$

$$\acute{\theta}_A\left(\Theta, \theta_J, \bar{c}_A\right) = \frac{\left(18+\bar{c}_J(-9+\theta_J(-1+2\theta_J)\bar{c}_J)\right)\nu}{\bar{c}_J(8-\theta_J\bar{c}_J)} \quad [10]$$

Equilibrium requires

$$\grave{\theta}_A\left(\Theta, \theta_J, \bar{c}_A\right) - \acute{\theta}_A\left(\Theta, \theta_J, \bar{c}_A\right) = 0 \quad [11]$$

A little algebra shows that equation [11] is a cubic equation in θ_J. As a result there may be multiple real roots and the possibility of multiple equilibria. For a characterization of equilibrium and their stability properties see Gray (2009). There it is shown that when one ethnicity engages in inter-ethnic and intercultural cooperation while the other engages only in inter-ethnic cooperation, there is a stable equilibrium with low levels of cooperation and the possibility of an unstable equilibrium with high levels of cooperation. The existence of an unstable equilibrium has important implications about the feasibility of reaching a cooperative equilibrium with both inter-ethnic and inter-cultural cooperation. To ensure the unstable equilibrium does not exist, the ethnicity engaging in inter-cultural cooperation must have a low enough population share. Figure 1-A demonstrates the possibility of multiple equilibrium when each population shares are equal so that $\nu = 1$ and $\bar{c}_J = \bar{c}_A = 2.5$. The solid line represents equation [9] and the dashed equation [10]. In equilibrium X a higher share of A's and lower share of J's choose the 'moderate' culture than in equilibrium Y but in

both cases less A's choose the cooperative culture than when both ethnicities restrict inter-culture cooperation. It is easy to show that much of the comparative static analysis, depends on the initial equilibrium, i.e. whether starting from X or Y.

For the purpose of comparison, a third type of equilibrium strategy is also worth discussing. Consider an equilibrium in which both ethnicities engage in inter-cultural cooperation. Gray (2009) also discusses this example and provides a diagrammatic derivation of equilibrium properties including the possible existence of multiple unstable equilibrium. Gray (2009) distinguishes stable, unstable and hyper-unstable regimes that can occur when both ethnicities engage in inter-cultural cooperation. Unstable regimes have the property that if individuals of a particular ethnicity over-shoot the equilibrium share of choosing M then all the individuals of the ethnicity will choose M causing equilibrium to breakdown. A hyper-unstable regime has the property that either ethnicity might cause the equilibrium to breakdown due to overshooting.

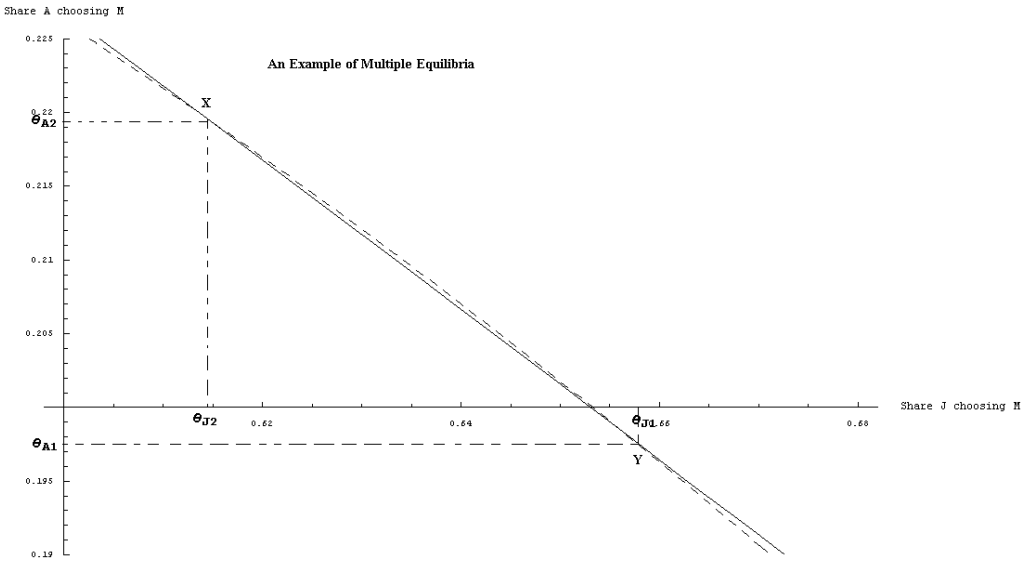

Figure 1-A

Using the same parameters as before, $\nu = 1$ and $\bar{c}_J = \bar{c}_A = 2.5$, an equilibrium of this type results in a unique outcome of 28.9% of each ethnicity choosing the moderate culture. If neither ethnicity cooperates across cultures then the outcome would involve 34.5% of each ethnicity choosing the moderate culture. Both of these equilibrium result in less individuals in J benefiting from inter-ethnic cooperation and more A's benefiting from inter-ethnic cooperation than in the asymmetric case where 60%-67% of those in J choosing moderation and cooperate across culture while 19%-21% of those in A choosing moderation and are isolated from about 80% of her ethnic population. Whether those that choose moderation are better off with inter-cultural cooperation or not is uncertain, but it is clear that if one ethnicity can restrict the other ethnic groups intra-ethnic relations, i.e. divide and conquer, while maintaining their cohesion enough to cooperate across cultures, they will make extreme gains at the other ethnicity's expense. Beliefs of which type of equilibrium will fall outside the model but their importance in determining equilibrium well-being suggest how culture and inter-cultural relations are intrinsically political in nature.

Conclusion

In highlighting an individual's choice of culture the model demonstrates the social constraints to that choice. The result of those constraints is that in different social environments, two otherwise identical individuals may choose extremely different life paths. The child soldier of Somalia may have been a doctor or lawyer given a different social environment. In another place, the white supremist and black nationalist might be business partners, and the truant gang member could, in different circumstances, be an honors student.

Although there are many types of equilibria that have not been flushed out, the three cases presented demonstrate how beliefs influence the type of equilibrium a society reaches and is suggestive as to the types of support a cooperation building institution

might proffer. Institutions that allow individual recognition would make it possible for stereotypes to be replaced with knowledge of the individual. When individual accountability replaces discriminatory practices the payoff to choosing a moderate culture and cooperation in meetings should increase for all non-extremists in society.

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Chapter 2

The Impact of Small Firm's Attributes

On the Choice to Apply and Application Outcomes

Introduction

Since the availability of the Survey of Small Business Finances (SSBF) which includes information on the race and credit history of firm owners, there has been a number of studies that have explored differences in the borrowing experiences of firms across demographic groups.[1] Cavalluzzo and Cavalluzzo (1998) suggested that including an interaction term of race and market concentration in a regression analysis was a good way to test for the presence of discrimination in credit markets. This idea was inspired by Becker's (1971) hypothesis that racial prejudice was less sustainable in highly competitive regions. Their 1998 application made a big impact on future research. The inclusion of the interaction term became standard practice in both linear and non-linear methods to test for discrimination in bank lending.

In a review of all the papers cited on the Federal Reserve Bank website that test for discrimination using the SSBF data, none tested for, or allowed for the possibility of statistical discrimination. If measures of quality differ in reliability across groups, or the mean or variance of quality differs across groups, then statistical discrimination implies that changes on the measure of quality will change expected quality differently across groups (Phelps, 1972; Aigner & Cain, 1977). If there is statistical discrimination then a correctly specified model should interact race on all measures of quality. Unless one makes strong assumptions on the groups being compared, a model that interacts race only with market concentration is mis-specified in the presence of statistical discrimination.

[1] (Berger & Udell, 1995; Bernstein, 2002; Cavalluzzo & Cavalluzzo, 1998; Cavalluzzo, Cavalluzzo, & Wolken, 2002; Blanchflower, Levine, & Zimmerman, 2003; Coleman, 2002; 2003; 2005; Reese, 2007) not to mention others.

Unless the authors of the previous work believe that taste based discrimination exist and statistical discrimination does not exist, their models are mis-specified. In linear regressions omitted variables orthogonal to included ones do not prevent consistency of estimates; however in non-linear analysis the same is not true. In logit and probit analysis omitted variables, even those orthogonal to the included independent variables, lead to inconsistent estimates (Greene, 2003, p. 673). This paper attempts to provide consistent estimates of taste based discrimination by properly specifying a model of loan approval if statistical discrimination is a reality.

Including interaction terms for each variable is equivalent to estimating the two groups separately. This is the approach taken here. It has been noted however, that comparing the coefficients from non-linear models estimated with samples with unequal variances is problematic[2] (Allison, 1999). The solution to this problem is to compare average marginal effects (AME) instead of coefficients or odds ratios (Mood, 2010). Thus, although the regressions coefficients will be shown the main focus will be on the AME of the entire population, whites and Blacks together, from the white model versus the Black model. For continuous variables the AME gives the average, across the total population, infinitesimal change to the probability of a loan being approved for an infinitesimal change of the variable, i.e. the average derivative. For discrete variables the AME gives the average change in loan approval for the discrete change, i.e. the average impact. If the AME differ across the Black and white models then race impacts the average benefit to the total population for a certain variable. With respect to Becker's (1971) hypothesis, the model suggests taste based discrimination if on average, the total population benefits differently from a change to a competitive environment in predictions of the Black model.

[2] The same problem of comparison arises for a dummy variable, or interaction term within a single model (Allison, 1999).

In addition to performing the standard probit analysis on the probability of approval, models that correct for sample selection and for heteroskadsticity in the error term are also included. Although the standard probit and sample selection model had results consistent with intuition, the heteroskadsticity corrected model did not perform as well. Even still, there were quite interesting results consistent across all three models. In all models the AME for a competitive region is higher for the Black model to at least a 95% confidence level providing evidence that even after adjusting for selection bias and the impact of statistical discrimination, taste based discrimination has a negative impact on firms seeking credit.

There is little that Black-owned firms can do to counter taste based discrimination. However, understanding the impact of statistical discrimination provides Black-owned firms useful tools to improving their access to credit. Consider that across all three models there is a significant benefit to being a family owned firm and that benefit is significantly different across races. Although not included in the final analysis, sc and ss-corporations were not significant in any of the analysis. Family owned may be significant because they in general do not benefit from bankruptcy protection. In that case, banks would have an easier time recouping defunct loans via family assets. Also, knowing the riskiness of a family business, business owners may take a more traditional approach, not overreaching in a way loan officers appreciate. Whatever it is, the racial prejudice of others is significantly more difficult to change than one's own actions. An additional benefit to including a test for statistical discrimination is that it may provide insight to avenues of access to credit for Black-owned firms.

Prior Research

There is abundant evidence that Black-owned firms benefit from higher competitive areas than white-owned firms when the possibility of statistical discrimination is not controlled for and there is not a lack of data. Cavalluzzo and Cavalluzzo (1998) cited a lack of Black firms in the 1998 survey as a cause of their inability to find evidence of discrimination in their study. In Cavalluzzo, Cavalluzzo and Wolken (2002) they made adjustments to include the 1993 data and more than doubled the number of Black firms included in their analysis. In that paper they found a significant difference between Black and white firms in the effect of being in a competitive region.

In a series of papers that examine the borrowing patters across demographic groups, Coleman (2002; 2003; 2005) finds evidence that Black-owned firms are less likely to apply for a loan due to fear of rejection but finds that interest rate differentials are small. Somewhat contrary evidence is presented in Blanchflower, Levine and Zimmerman (2003) who find that while Black-owned firms are less likely to apply due to fear and that they are charged significantly higher interest rates after controlling for observables.

Two other related lines of research have to do with credit sources for small firms and differences across banks in allocating credit. Cole and Wolken (1996) studied the sources of credit for small firms. They found that banks are the primary source of credit for small firms. This suggests that focusing on discrimination in loan approval by banks is most pertinent to small-firms. Although banks are the focus of this paper, others have studied trade credit. In particular, Coleman (2005) and Reese (2007) studied differences in access to trade credit across demographic groups. Both find evidence of discrimination against Black-owned firms. Cole, Goldberg and White (2004) find significant differences in lending patterns of banks of differences

sizes summarizing the differences as saying that bigger banks have more formal standards. Their results motivate the interactions of formal standards with bank type in the analysis presented.

In total, there is a wide range of evidence that uses the Becker (1971) hypothesis to demonstrate disadvantages to access to Black-owned firms in accessing credit. This paper adds to the evidence by presenting evidence that takes into account the possibility that banks statistically discriminate. In doing so it provides asymptotically consistent evidence that demonstrates consistent estimates of the Becker effect, that are statistically significant, and stronger with sample selection.

Empirical Framework and Description of the Data

Discrimination has been defined as, occurring "whenever the terms of a transaction are affected by personal characteristics of the participants that are not relevant to the transaction" (Blanchflower, Levine, & Zimmerman, 2003). Although the definition is concise, it loses it precision in a world with statistical discrimination. When measures of quality vary with race does race become relevant to the transaction? Is its use in the transaction no longer discrimination?

The framework taken here is to determine the impact changes in measures of quality have on approval rates for white and Black-owned firms separately. This is the equivalent to estimating one model with interaction terms for race on every variable. Included in the model is also market concentration. After estimating each model the AME is estimated for the total population. Significantly different AME suggest statistical discrimination. More importantly, in some cases they suggest where Black firms should focus their resources, i.e. improving credit ratings may on average be more beneficial for Black firms than it is for white firms. In the spirit of Becker (1971) and Cavalluzzo and Cavalluzzo (1998) the finding of significantly different AME for market concentration is evidence of taste based discrimination. To the

author's knowledge there has never been a model of small-business financing that includes a test of statistical discrimination. Thus, all previous test of discrimination suffer from omitted variable bias if statistical discrimination is a reality.

The national data from the 1998 and 2003 Survey's of Small Business Finances (SSBF) are used to estimate the model. The 1998 survey was conducted in 1999 and 2000 for firms in business in 1998. Information was collected for 3,561 firms. Information on the firm's credit score, owner's race, owner's wealth, firm's profit, sales, and a host of other potentially relevant information was included. The 2003 survey was conducted in 2004 and 2005 and has information for 4240 firms. In both surveys Black-owned firms were over sampled but with the supplied weights the surveys were nationally representative of 5.3 and 6.3 million small businesses respectively.

The focus of this paper is on differences between Black and white-owned firms thus other minority firms were excluded. There were 3844 white and 122 Black firms in 1998 and 2885 white firms and 274 Black firms in 2003. In 1998 white firms applied 36% of the time compared to 34% for Black firm while this switched in 2003 where only 24% of the white firms applied and 29% of the Black firms applied[3]. Although application rates were similar across races approval rates were drastically different. Whites experienced approval rates of 88% and 78% in 1998 and 2003 whereas Blacks experienced approval rates of 40% and 43%.

This high difference in loan approval rates is not in itself evidence of discrimination as Black-owned firms were as a group less credit worthy than white owned-firms. Table 2-A reports some differences in creditworthiness across race. Only 3% of white-owned firms had judgments against them as opposed to 9% of Black-owned firms. Black-owned firms were less likely to have low risk credit

[3] All percentages, means and medians are for sample weighted data.

ratings, 24% versus 29%, and no delinquencies, 67% versus 89%, while being three times more likely to have more than three delinquencies,18% versus 6%.

Table 2-A

Characteristics of firms in 1998 and 2003 SSBF

Variable	White	Black
N	6729	396
1998 Firms	45%	47%
No Owner Del	89%	67%
Over 3 Owner Del	6%	18%
No Firm Del	85%	79%
Over 3 Firm Del	9%	12%
No Judgments	97%	91%
Low Risk Firm	29%	25%
High Risk Firm	41%	44%
Family Owned	49%	49%
Global	4%	4%
Used Commercial	73%	75%
Competitive Area	5%	6%
Loan for Business Capital	3%	1%

Table 2-B reports that white owned firms have larger mean and median profit, sales, and assets than Black-owned firms. This lack of wealth is important as it could be used as collateral for a business loan (Blanchflower, Levine, & Zimmerman, 2003). Also, white-owned firms are larger, with a median size of 5 or 7 employees depending on year compared to 3 employees for Black-owned firms. White-owned firms are also

Table 2-B

Mean and Median Firm Characteristics by Year and Race

Year 1998 Variable	White	Black
N	2885	274
Mean Profit in thousands	607.7	237.2
(Median)	(32.5)	(13.1)
Mean Sales in thousands	4,031.4	777.5
(Median)	(302.0)	(75.2)
Mean Assets in thousands	1,743.2	196.7
(Median)	(122.2)	(29.5)
Mean Employees	28.6	12.6
(Median)	(5)	(3)
Mean Owner Age	51.3	49.3
(Median)	(51)	(49)
Mean Firm Age	15.2	11.3
(Median)	(12)	(9)
Year 2003 Variable	White	Black
N	3844	122
Mean Profit	613	254.9
(Median)	(36.3)	(8.4)
Mean Sales	4,754.5	1,071.6
(Median)	(515.4)	(72.9)
Mean Assets	2,424.2	455.4
(Median)	(196.8)	(45)
Mean Employees	32.5	19.1
(Median)	(7)	(3)
Mean Owner Age (Median)	53.2	51.7
(Median)	(53)	(52)
Mean Firm Age (Median)	16.8	12
(Median)	(14)	(9)

older. All of these characteristics may be factors in the overall difference in approval rates that must be controlled for. They are also factors that suggest statistical discrimination might be a reality in the credit market. As the distributions of measures of quality have drastically different distributions across the races they may impact a loan officers decision differently even if there is no taste for prejudice.

Econometric Evidence

Standard Probit

The evidence presented to this point has demonstrated that Black-owned firms are denied loans at higher rates than their white counterparts. Additionally, the two groups have strikingly different characteristics. It is plausible that a loan officer finds it rational to makes decisions of loan approval conditional on race even without a taste for race prejudice due to variations in the reliability of measures of quality. To test for discrimination in non-linear models it is important to correctly specify the model to avoid inconsistency of estimators. As such, a probit analysis of the probability of loan approval is done for Blacks and white owned firms separately. Taking cues from the wealth of papers before the model estimated is

$$\Pr(app=1)=F[a + b_1 ind98 + b_2 no\_own\_de1 + b_3 no\_firm\_del + b_4 no\_judgment + b_5 lowrisk + b_6 home\_own + b_7 educ + b_8 banktype + b_9 fam + b_{10} global + b_{11} lnsales + b_{12} lnprofit + b_{13} lnliabilities + b_{14} lnassets + b_{15} lnloansiz + b_{16} siz1 + b_{17} siz4 + b_{18\text{-}22} ssic3\text{-}7 + b_{23} hh1 + b_{24} lnexper + b_{25} lnfirmage + b_{26} banktype*lnsales + b_{27} lnassets*lnliabilites + b_{28} no\_own\_de1*banktype + b_{29} female]$$

The two estimations provided very different results. The coefficients from the two estimates are provided in Table 2-C. Having performed the analysis it is tempting to ask the question, “Would a Black-owned firm be better if he could disguise himself as white?” Figure 2-A presents an answer to the question. The horizontal-axis is a

Black-owned firm's predicted probability given the probit with Black-owned firms.

The y-axis is the firms predicted probability given the probit with white-owned firms.

Table 2-C

	Standard Probit Coefficients			
	White Only		Black Only	
appr				
----------				
ind98	-0.3812978	**	1.620294	***
no firm del	0.3455906	*	-0.212099	
no own del	0.5696992	***	0.2427412	
no judge	0.3339406		0.950536	**
low risk	0.1643365	*	-0.3479418	
own house	0.4685792	***	0.3103189	
max ed GED	-0.1357829		-0.3726531	
not family owned	0.015116		-1.40092	**
comm bank	-1.300075	**	-3.291951	
global firm	-0.5137631	***	-0.4625773	
log sales	-0.0258004		0.1222869	
log profit	0.0215129	**	0.0011785	
log liability	-0.1330909	***	0.0058284	
log assets	-0.0415182		-0.0619081	
log loan size	-0.0957462	***	-0.2020567	**
< than 10 workers	0.0202157		-0.019096	
> than 400 workers	0.0003439		0.7769728	
not competitive mkt	-0.5061807	**	-1.864574	**
owner experience	-0.0338337		-0.2046295	
log firm age	0.2349348	***	0.0747843	
comm bank*firm sales	0.0834446	**	0.1312304	
log assets*log liability	0.0110742	***	0.0076839	
no owner del* comm bank	-0.0104544		1.618484	**
not female	-0.0853452		-0.2307684	
ssic industry codes				
Constant	1.830046	**	2.896378	
pseudo R-squared	0.1493		0.2869	

*** imply coefficient is significant at the .01 level, ** imply coefficient is significant at the .05 level and * imply coefficient is significant at the.1 level.

There is a diagonal representing the 45degree line. Any observation above the 45degree line is better off with a disguise. Note that this picture, though accurate in the sense that it reflects the results from the estimation, is only provocative as it gives individual effects not average effects. It thus suffers from the problems of group

comparisons in non-linear models (Allison, 1999). This is why, although coefficients are provided for all of the estimates, the focus will be on AME and the author suggests the reader focuses on the AME. For an average comparison, note that if the cutoff for approval is a probability of success of 50%, then the Black model would estimate a 53% approval. The white model would estimate the same Black population as having an 87% approval rate.

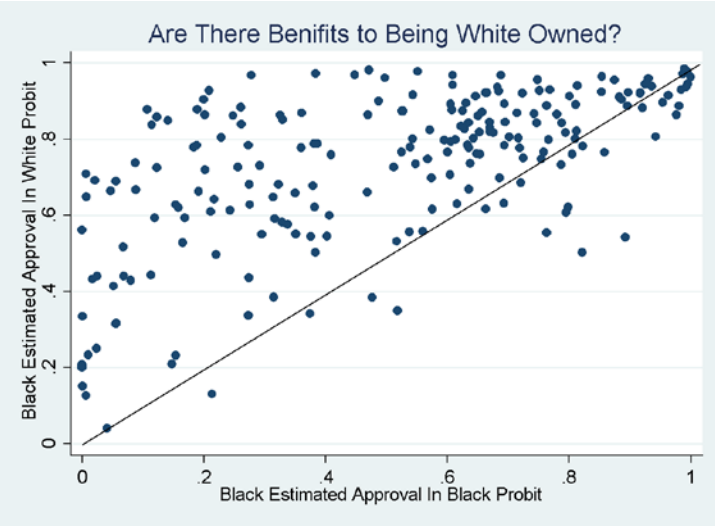

Figure 2-A

More important for the analysis is the AME implied by each model. The AME for the standard probit is given in Table 2-D. For a continuous variable, the AME gives the average change the variable has on the loan approval for an infinitesimal change. For a discrete variable it gives the average change in the probability of loan approval. Given that the AME is calculated for the total population, not the subpopulations white or Black, the AME are comparable.

In both models having no firm delinquencies, on average, increases the probability of loan approval, whereas the larger the size of the loan being applied for, the lower, on average, the probability of the loan being approved. Additionally, not being in a competitive environment reduces the probability of a loan being approved.

Table 2-D

Average Marginal Effects of Full Population From Standard Probit Analysis

	dy/dx Based on White Probit		dy/dx Based on Black Probit		
ind98	-0.0833703	**	0.3779365	***	+++
no firm del	0.0772184	***	0.2656498	***	++
no own del	0.1423543	***	0.068318		
no judge	0.0792998		0.2633124	**	
low risk	0.0334082	*	-0.0969263		+
own house	0.1142823	***	0.0869264		
max ed GED	-0.0284938		-0.1033964		
not family owned	0.0031616		-0.3411595	***	+++
comm bank	-0.0547034	***	-0.1044779		
global firm	-0.1286291	***	-0.1296772		
log sales	0.0077595		0.0589661	*	+
log profit	0.0045025	**	0.0003249		
log liability	-0.0013591		0.0262829	***	++
log assets	0.0157949	***	0.0050911		
log loan size	-0.0200391	***	-0.0557075	**	
< than 10 workers	0.0042568		-0.005262		
> than 400 workers	0.000072		0.1948548		
not competitive mkt	-0.0858849	***	-0.3761209	***	+++
owner experience	-0.0070812		-0.0564168		
log firm age	0.0491703	***	0.0206182		
not female	-0.0175421		-0.0631135		

*** imply AME is significant at the .01 level, ** imply AME is significant at the .05 level and * imply AME is significant at the.1 level.

+++ imply AME is significantly different across models at the .01 level, ** imply AME is significantly different across models at the .05 level and * imply AME is significantly different across models at the .1 level.

In some cases measures of quality may serve as substitutes for the two groups. An example is that no owner delinquency and having low risk have significant AME in the white analysis whereas in the Black analysis having no judgments on average significantly increases the probability of loan approval. An interesting result that will be found in all of the models presented is the AME of having a family business in the Black analysis. Although there is no effect from the white analysis, there is a

substantial, 34%, increase on average in having a loan approved for family businesses according to the Black analysis. Although corporations were not included in the final analysis it should be noted that the inclusion of ss and sc type corporations did not change the result and were not significant.

Another result is related to Cole, Goldberg and White's (2004) work on bank size. The AME from the white analysis finds that on average commercial banks are 5% less likely to approve a loan than non-commercial banks. Although the AME are not significant in the Black analysis it is still evidence that commercial banks have higher standards than their counter-parts.

The other AME from the white analysis are fairly intuitive. Positive measures of credit on average increase the likelihood of a loan being approved. Owning a house, having high profits, and having low liabilities, all on average, increase the probability of a loan being approved. Additionally, on average the larger the loan applied for the lower the probability the loan will be approved.

The AME from the Black analysis had less significant variables although the pseudo R-squared from the Black probit was higher, this could have been related to the lower sample size from which the regression was based. On average, not having judgments is very significant to effecting loan approval rates, being family owned, sales, liabilities and the Herfindahl index were the primary variables effecting loan approval.

Wald tests for significance between the AME resulting from the two models suggests there is a significant difference in the impact of have no firm delinquency, low risk, a family owned business, sales and liabilities, as well as the year. More importantly for a test of taste based discrimination the model finds that although both models predict significant AME due to changes in competitiveness, the Wald test finds they are significantly different. The Black based probit predicts a larger change in

loan approval when moving out of a competitive region. Thus after controlling for all twenty seven characteristics and allowing for statistical discrimination, there is still strong evidence that Black owned firms face taste based discrimination.

As it may be pointless to rid the world of taste based of taste based discrimination an additional lesson to Black-owned firms may be to reduce their firm delinquencies, and increase their sales as the analysis suggest it is more helpful for them than their white counterparts.

Probit w/ Sample Selection

Many researchers have noted that bank applicants are a self-selected group (see for example Blanchflower, Levine, and Zimmerman (2003) and Cole, Goldberg, and White). The presumption is that only firm owners that believe they have a high chance of receiving a loan would bother to apply. If the self-selection mechanism is symmetric across race then measures of discrimination would be unaffected by the process. However, if for example, Blacks-owned firms use unobservable information that makes them more cautious in applying for loans, then a model of loan approval that does not include these unobservables would underestimate race bias.

The 1998 and 2003 SSBF collected data on why firms that wanted credit may not have applied for credit. This information seems like the Holy Grail for researchers looking for a way to identify selection issues in loan applications that varied across race. An example comes from Blanchflower, Levine, and Zimmerman (2003) who use the new data to test if Black-owned firms are less likely to apply for a loan due to fear of rejection. They find that Black-owned firms do self-select out of the applicant pool due to fear of rejection more than white firms. Cavalluzzo, Cavalluzzo, and Wolken (2002) perform similar test and find similar results. They however go further by performing a simultaneous equation analysis on fear of rejection and approval rates as a way to estimate for sample selection. The problem with this line of inquiry and

the use of fear of rejection to correct for sample selection is the strong correlation of fear of rejection with the loan approval. To correct for sample selection a proxy for applying is needed that is not strongly related to the approval process (Greene, 2003, p. 86). The basic problem of sample selection is that there is unobservable information but since fear is highly correlated to approval, an observable, fear is not providing additional information. The point is that people with fear of applying typically do so because of other observable measures of quality. The fact that Black-owned firms have higher fear is suggestive that they recognize that higher standards

Table 2-E

Fear vs #of Institutions and Owner Age

White	Number of obs = 6669	R-squared = 0.1636
	Apply=.3963418 -.139035*lnonage+ .4210136*lnninst	
	Number of obs = 6729	R-squared = 0.0103
	Apply=.2821189 +.1186583*fear	
Black	Number of obs = 396	R-squared = 0.1376
	Apply = 1.221587-.3161339 * lnonage+.3191717*lnninst	
	Number of obs = 396	R-squared = 0.0653
	Apply = .1939754 +.2383943*fear	
White	Number of obs = 2555	R-squared = 0.0220
	Approve= .1466223+.207133* lnonage-.0839415*lnninst	
	Number of obs = 2599	R-squared = 0.1788
	Approve= .9315061-.3552661* fear	
Black	Number of obs = 132	R-squared = 0.0199
	Approve=-.131576 +.0938922*lnonage + .1403639*lnninst	
	Number of obs = 132	R-squared = 0.2573
	Approve.8036183 -.5506695*fear	

exist in the credit market. Nevertheless, the high correlation between approval rates and fear and the small correlation between fear and applying make fear of applying a bad variable for a model of sample selection.

Although fear of approval does not meet the standard of a good instrument for a sample selection model two other variables do. The number of institutions a firm is associated with and the firm's owner's age are highly correlated with a firm's decision to apply. The regressions results can be found in Table 2-E. Fear of applying had a R-squared of between .01 and .07 when explaining application decisions while number of institutions and owner age have R-squares ranging between .13 and .16. On the other hand, owner fear is highly correlated with rejection, suggesting owners have reasons to fear whereas the number of institutions and its owner's age are not a cause of concern. Younger owners are more likely to apply and the more institutions a firm is associated with the more likely it is to apply even after controlling for the other firm characteristics. Neither of these variables, even when significant, provides much explanation to why firms are approved or denied loan applications. Thus, together they provide a mechanism to test for sample selection.

Using these two variables sample selection is modeled as follows,

$y_1=0$ $\quad\quad$ $Pr(y1=0)= \Phi(-x_1\beta_1)$

$y_1=1,\ y_2=0$ $\quad\quad$ $Pr(y1=1,y2=0)= \Phi(x_1\beta_1)- \Phi(x_1\beta_1,\ x_2\beta_2,\rho)$

$y_1=1,\ y_2=1$ $\quad\quad$ $Pr(y1=1,y2=1)= \Phi(x_1\beta_1,\ x_2\beta,\rho)$

$E[\varepsilon_1|\ x_{1,}\ x_2]= E[\varepsilon_2|\ x_{1,}\ x_2]=0,$

$Var[\varepsilon_1|\ x_{1,}\ x_2]= Var[\varepsilon_2|\ x_{1,}\ x_2]=1,$

$Cov\ [\varepsilon_1,\varepsilon_2|\ x_{1,}\ x_2]= \rho$

The vector for the application decision, x_1, includes everything except those connected with loan size and bank type while adding owner age and the number of institutions

associated with a firm. The vector x_2 is the same as in the first probit analysis. The point estimates suggest that white-owned firms are responsive in their application decisions to the included variables. Those without delinquencies or judgments are less likely to apply for credit. Also those with education and large firms are less likely to apply for credit. The model suggests the young white owners are significantly more likely to apply for credit while the same is not true for Black owners. For Black firms however, the probability to apply does significantly decrease with firm age.

The AME from the white probit with sample selection given in Table 2-F are not strikingly different from the standard probit. The AME of females is still insignificant and the impact of being in a competitive region is now only significant at the 90% level. Now the AME from assets and liabilities are significant. The signs of all AME are intuitive. Better measures of credit, assets and sales/profits all improve the probability a loan will be accepted. Commercial banks still exhibit higher standards.

Table 2-G gives the AME from the Black probit with sample selection. The model is consistent with the standard probit presented earlier. The AME for no firm delinquencies and no judgments are significant although low credit rating is still insignificant. Being a family business increases loan approval probability on average by 34%. The AME on sales and liabilities have the expected sign. What might be most interesting for the discussion of discrimination is that the sample selection model predicts an AME 5% higher for changes in market competitiveness. This suggests that not accounting for sample selection did understate the effect of discrimination.

Table 2-F

Probit model with sample selection (Whites Only)

	Coef.			Coef.	
appr			apply		
ind98	-0.4828118	***		-0.4665531	***
no firm del	0.1816301			-0.1184418	*
no own del	0.4447266	***		-0.0257476	
no judge	0.1628723			-0.3182001	**
low risk	0.1612957	**		0.0461607	
own house	0.4377248	***		0.0743573	
max ed GED	-0.0688219			0.0871899	*
not family owned	0.0299546			0.1570861	
comm bank	-1.193938	***			
global firm	-0.4877181	***		-0.1412013	
log sales	0.0054727			0.029398	*
log profit	0.0179272	**		-0.0037245	
log liability	-0.0793497			0.0316545	
log assets	-0.0384962			-0.0151775	
log loan size	-0.0776944	**			
< than 10 workers	0.0297697			-0.0071366	
> than 400 workers	-0.157007			-0.2706279	**
not competitve mkt	-0.3568173	*		0.1704396	*
owner experience	-0.0824513			-0.0335178	
log firmage	0.1930321	***		0.0093123	
comm bank*firm sales	0.073468	**			
log assets*log liability	0.0109224	***		0.0033941	
no owner del*comm bank	0.0034847				
not female	-0.0314967			0.0416071	
SSIC Code					
Constant	0.3397761		log # inst	0.9667311	***
			log owner age	-0.5241604	***
			Constant	-0.1257977	
	/athrho |	0.8088122	rho |	0.6689345	

Wald test of indep. eqns. (rho = 0): chi2(1) = 24.19 Prob > chi2 = 0.0000

*** imply coefficient is significant at the .01 level, ** imply coefficient is significant at the .05 level and * imply coefficient is significant at the .1 level.

Holding all these factors constant, Table 2-H shows that the models with sample selection finds a significant difference between the impact of being in a competitive region. Thus even when statistical discrimination is accounted for the AME across models suggest taste based discrimination is an issue for Black-owned

firms. Further incorporating selection bias increases the evidence of taste based prejudice.

Table 2-G

Probit model with sample selection (Blacks Only)

	Coef.		Coef.	
appr			Apply	
ind98	1.61439	***	-0.3314949	
no firm del	-0.3673536		0.0299089	
no own del	0.260039		-0.0963104	
no judge	0.7826499	*	-0.2279043	
low risk	-0.3302871		0.0844349	
own house	0.2581799		0.0740478	
max ed GED	-0.3490963		0.2148995	
not family owned	-1.442326	**	0.0808877	
comm bank	-3.651755	*	-	
global firm	-0.387683		0.1284177	
log sales	0.1204878		0.0289233	
log profit	-0.0050614		-0.0104027	
log liability	0.0212245		0.0188061	
log assets	-0.0563037		0.0129437	
log loan size	-0.1977025	**	-	
< than 10 workers	0.0121866		0.0738981	
> than 400 workers	0.8285711		0.6643673	
not competitive mkt	-1.782041	***	0.3064434	
owner experience	-0.2397649		-0.0508969	
log firmage	-0.0072464		-0.2508322	**
comm bank*firm sales	0.1622953			
log assets*log liability	0.0074279		0.0005458	
no owner del*comm bank	1.628855	***		
not female	-0.1052491		0.0844058	
SSIC Code				
Constant	2.430285			
		log # instit	1.093348	***
		log owner age	-0.7104433	
		Constant	-0.1163215	\
/athrho |	0.5099991			
rho |	0.4699445			

Wald test of indep. eqns. (rho = 0): chi2(1) = 1.47 Prob > chi2 = 0.2252

*** imply coefficient is significant at the .01 level, ** imply coefficient is significant at the .05 level and * imply coefficient is significant at the.1 level.
The AME from the white probit with sample selection given in

Table 2-H

Average Marginal Effects of Full Population

	dy/dx Based on White Sample Selection Probit		dy/dx Based on Black Sample Selection Probit		
ind98	-0.1647758	***	0.3929958	***	+++
no firm del	0.0618027	*	0.1971002	**	
no own del	0.1539821	***	0.0724932		
no judge	0.0547308		0.2023962	*	
low risk	0.052669	**	-0.0920349		++
own house	0.1507282	***	0.0715404		
max ed GED	-0.022694		-0.0985142		
not family owned	0.0098362		-0.3400196	***	+++
comm bank	-0.0877471	***	-0.0772671		
global firm	-0.1667008	***	-0.1054889		
log sales	0.0194245	**	0.0651252	**	
log profit	0.005904	**	-0.001419		
log liability	0.0156333	***	0.030551	***	
log assets	0.0247823	***	0.0068553		
log loan size	-0.0255871	***	-0.0554261	**	
< than 10 workers	0.0098209		0.0034132		
> than 400 workers	-0.0525963		0.2299245		
not competitive mkt	-0.1113514	*	-0.4401842	***	+++
owner experience	-0.0271537		-0.0672183		
log firm age	0.0635713	***	-0.0020315		
not female	-0.0103495		-0.0295543		

*** imply AME is significant at the .01 level, ** imply AME is significant at the .05 level and * imply AME is significant at the.1 level.

+++ imply AME is significantly different across models at the .01 level, ** imply AME is significantly different across models at the .05 level and * imply AME is significantly different across models at the .1 level.

Heteroscedasticity adjusted Probit

As a final specification test a model that allows for heteroscedasticity in the error term is presented. It is hypothesized that the heteroscedasticity is due to changes in bank decision making for firms with different levels of firm profits. The variance

of profit is extremely high amongst firms. If banks have a different set of rules for those few firms with very high profits than the model estimates will be inconsistent unless the variance of the error term is allowed to incorporate profit. Here the variance equation is specified as,

$$\text{Var}[\varepsilon_i] = \exp(\gamma_1 profit + \gamma_2\ profit * profit)$$

Profit was included as a quadratic primarily because it produced a better fit than only including the single profit measure. Everything else is the same as the original probit model. In none of the test did heteroscedasticity seem to be important to the white analysis but it seemed very important to the Black analysis. This could be due to the prevalence of young firms and firms with poor credit. Both types of firms would be types that might meet exemptions from certain conditions for loan approval given high enough profits.

The results from the heteroscedasticity models, Table 2-I, left something to be desired. The variance equations for the white probit found neither profit coefficient to be significant indicating that it was mis-specified. The predicted signs and significance of the AME were not however impacted (see Table 2-J). Measures indicating creditworthiness, with the exception of judgments, assets, sales and profits all significantly increased average loan approval. Commercial banks on average were less likely to approve a loan and the larger the loan applied for the larger on average the chance of approval.

The Black model is a different story. Both coefficients on profit were highly significant in the variance equation indicating an allowance for heteroscedasticity in the error term was correct. However, many of the implied AME resulting from the Black heteroscedasticity adjusted model were counterintuitive. Consider that owner experience, having a low risk firm, home ownership and profit, all showed up as on average significantly reducing loan approval. It is possible that the correlation

amongst other variables in the model caused the counterintuitive result but at this point it is difficult to determine.

Table 2-I

	White Only HetProbit Coefficents		Black Only HetProbit Coefficents	
appr |				
ind98	-0.4156064	**	5.864902	
no firm del	0.3573229	*	0.0169163	
no own del	0.5939274	***	0.1230347	
no judge	0.3377338		0.3131139	
low risk	0.1762948		-0.1036879	
own house	0.4885683	***	-0.0921066	
max ed GED	-0.139744		-0.0648079	
not family owned	0.0205125		-5.943003	
comm bank	-1.393331	**	-0.0144346	
global firm	-0.5263515	***	-0.0680068	
log sales	-0.0326337		0.0897957	
log profit	0.0266579		0.0214726	
log liability	-0.135433	***	-0.0462265	*
log assets	-0.0391618		-0.0357966	*
log loan size	-0.1010986	**	-0.0237004	
< than 10 workers	0.0344752		0.0052707	
> than 400 workers	-0.0218717		-0.2232929	
not competitive mkt	-0.5506282	**	-0.4386814	*
owner experience	-0.0380836		-0.105954	
log firm age	0.2556913	***	0.067462	
comm bank*firm sales	0.0886554	**	-0.022712	
log assets*log liability	0.0109559	**	0.0062062	*
no owner del*comm bank	-0.0053938		0.280308	
not female	-0.099143		-0.2427213	*
SSIC Codes				
Constant	1.99065	**	0.0492068	
----------+- ----------		----------		
lnsigma2 |				
log profit	0.0438896		-1.306784	***
|				
log profit*log profit	-0.0033045		0.1069073	***
--------------- ----------		----------		
Wald test of lnsigma2=0:			Wald test of lnsigma2=0:	
chi2(2) = 1.25 Prob > chi2 = 0.5346			chi2(2) = 18.68 Prob > chi2 = 0.0001	

Without determining the cause of these results, likely correlation amongst the independent variables, drawing inferences from this model lacks credibility.

Table 2-J

Average Marginal Effects of Full Population

	dy/dx Based on White Het Probit Coef.		dy/dx Based on Black HetProbit Coef.		
ind98	-0.0858515	**	0.4162528	***	+++
no firm del	0.076003	***	0.1591718	***	
no own del	0.1396104	***	0.090803	*	
no judge	0.0752097		0.2213778	***	
low risk	0.0337777	*	-0.0759648	*	++
own house	0.1121305	***	-0.0585813	**	+++
max ed GED	-0.0276532		-0.044277		
not family owned	0.0040438		-0.5642583	***	+++
comm bank	-0.0561171	***	-0.0479386	*	
global firm	-0.1236049	**	-0.045674		
log sales	0.0067747		0.0492255	***	++
log profit	0.0075816	**	-0.0368778	***	+++
log liability	-0.0019689		0.0142492	***	++
log assets	0.015207	**	0.0140878	*	
log loan size	-0.0199475	***	-0.0157343		
< than 10 workers	0.0068679		0.0034989		
> than 400 workers	-0.0043519		-0.1569913		
not competitve mkt	-0.0875134	***	-0.1906506	***	++
owner experience	-0.0075142		-0.070341	**	+
log firmage	0.0504498	***	0.0447868	**	
not female	-0.0191737		-0.1499887	***	+++

*** imply AME is significant at the .01 level, ** imply AME is significant at the .05 level and * imply AME is significant at the.1 level.

+++ imply AME is significantly different across models at the .01 level, ** imply AME is significantly different across models at the .05 level and * imply AME is significantly different across models at the .1 level.

All is not lost however because heteroskedasticity in the errors has not been a focus of the discussion in determining whether there is discrimination in credit

markets. Although the model presented here is clearly mis-specified the variance equation for Black probit is significant suggesting heteroskedasticity is an issue that should be perused. In order to do this it is necessary to reduce correlation amongst the number of independent variables invariably focusing on which are most important in explaining the loan approval decision.

Conclusion

This paper has built on previous work on discrimination in small business access to credit by incorporating the possibility of statistical discrimination in its estimation framework. In addition, it presented a model that compensated for selection bias in the loan decision process. The findings are significant. Even after accounting for statistical discrimination evidence of taste based discrimination still exist. Further, when selection bias is accounted for the evidence of taste based discrimination is even stronger.

Previous research presented asymptotically inconsistent estimates of the impact of discrimination because of omitted variable bias. If there is statistical discrimination as well as taste based discrimination then all measures of quality should be interacted with race. This is the first paper to do so when attempting to measure discrimination in small business access to credit. In order to make across group comparisons it is necessary to compare AME (Allison, 1999; Mood, 2010). Even still, there are strong effects that increase when sample selection is accounted for.

In addition to providing consistent estimates of discrimination incorporating statistical discrimination gives Black-owned firms insight into mechanisms to improve their probability of loan approval. One result that came out across models was that family owned firms on average have a higher loan approval rate for Blacks (see Table 2-K). This could be related to lack of bankruptcy protection that gives banks an additional layer of security in providing loans. Also, the models made it clear the

importance of not having judgments or firm delinquencies for having a loan approved. Instead of focusing on the prejudice of others, Black-owned firms may do better by focusing on ways to increase their loan approval probabilities. This analysis provides them that insight.

Table 2-K

Comparison Across Specifications

	Probit	HetProbit	Sample Selection
ind98	+++	+++	+++
no firm del	++		
no own del			
no judge			
low risk	+	++	++
own house		+++	
max ed GED			
not family owned	+++	+++	+++
comm bank			
global firm			
log sales	+	++	
log profit		+++	
log liability	++	++	
log assets			
log loan size			
not competitive mkt	+++	++	+++
owner experience		+	
log firmage			
not female		+++	

+++ imply AME is significantly different across models at the .01 level, ** imply AME is significantly different across models at the .05 level and * imply AME is significantly different across models at the .1 level.

An important avenue for future idea is to account for unobserved heterogeneity in the error term. There is evidence that the variance of the Black probit is a function of firm profit however doing so creates counterintuitive AME in the model. This is possibly the result of correlated independent variables. The variance in the white error did not follow the same pattern. Sorting out this unobserved heterogeneity would allow for better estimates of discrimination.

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Chapter 3[4]

Literacy Traps:

Societal Education and the Skill Premium

Introduction

The idea that an economy or a group of people can get caught in a low-level trap from which it is, in principle, possible to escape but no *individual* has it within his or her power to break out of it is an old one in economics, but its importance has remained undiminished. Among Tapan Mitra's many fields of enquiry in economic theory, poverty traps has been a significant one. In 1995, in a joint paper with Mukul Majumdar, for instance, he explores the relation between increasing returns and poverty traps and how an economy can be caught in poverty, though once it is wrenched out of the trap it can grow unassisted (Majumdar and Mitra, 1995; see also Majumdar and Mitra, 1982; Dechert and Nishimura, 1983). This work is a natural extension of the idea of vicious circle of poverty to be found in Nurkse (1953) and Rosenstein-Rodan (1943) and also the idea that there is a close connection between underdevelopment and multiple equilibria (Basu, 1997).

While the dominant discussion of low-level traps has occurred in the context of a nation's or a collectivity's income, it is possible to carry the broad idea over to other indicators of a nation's well-being (see Hoff and Stiglitz, 2001). In the present paper, we try to show that something similar may happen regarding literacy. A nation can get caught in a low-literacy or low-education trap. Once caught in this situation, it is not in the interest of any individual to incur cost and acquire a lot of skills. It is the skill-lessness of others that makes it not worthwhile for each individual to acquire much skills, and thus they are all trapped in a vicious circle.

[4] This chapter was jointly written with Atal, V., Basu, K. and Lee, T.

Our analysis has important policy implications. A nation caught in a low-literacy trap cannot break out of it just by providing schools for it is not the supply of schools that is a bottleneck but the demand for higher education. Hence, the rather abstract model that we are about to construct can shed light on significant policy questions such as when do we need to make education compulsory and when will the simple act of making schools available take care of the problem of under-investment in human capital. The model sheds interesting light on how, in a certain class of equilibria, giving a subsidy to education may have no effect on promoting education. In the process we get some insights into the design of policy that will be effective.

The core of our model is based on the idea of an O-ring production function, introduced in the literature by Kremer (1993) -- see also Kremer and Maskin (1996). The idea is this. Since so much of today's work takes the form of the assembly line, either literally, as in the manufacture of cars, or, in effect, as in software services, where small groups are engaged in doing different parts of a large job, that a malfunction in one part can undo the benefits of the other tasks that are done well. The metaphor is that of the space shuttle Challenger disaster in 1986, which was caused by the malfunctioning of a tiny component of the space-ship, the O-ring. The idea that there will be this kind of spillover effects of education among workers seems natural enough and there has been a lot of empirical and theoretical work on this (Rauch, 1993; Benabou, 1993; Redding, 1996; Acemoglu and Angrist, 2000; Kremer, Miguel and Thornton, 2004; Moretti, 2004).

In Kremer's O-ring model, the skill that workers bring to their task is innate to the worker. If, however, we introduce education in the model, whereby each worker has the choice of incurring some cost (in terms of both time and money) and improving their skills and ability to do their jobs better, then interesting equilibria arise, including the possibility that workers will get caught in a low-education trap. This is the central

idea that is pursued in this paper and while poverty traps are a pervasive topic in economics, low-literacy traps seem to have received much less attention. The work most related to our paper is that by Jones (2008). He constructs a random matching model in which there is endogenous human capital accumulation. Each individual faces the choice to be trained as a generalist or a specialist, with the value of being a specialist increasing as the density of specialists in the population rise. In Jones' model, for certain parameter values, there is the possibility of multiple equilibria since the economy could be one of specialists or generalists. Another related exercise (Basu and Weibull, 2003; Horowitz, 2008) studies the punctuality traits of a collectivity, where each person benefits from other people's punctuality and also the marginal return to increased individual punctuality rises with the level of other people's punctuality. This strategic complementarity easily leads to multiple equilibria, whereby two societies of a priori identical individuals can get caught in, respectively, a tardy and a punctual equilibrium.

Model

A Primer on O-Rings

It is useful to begin by briefly summarizing the O-ring model, while at the same time adapting it a little to our present need. There is one consumer good in the economy. Its production takes place in factory units or, simply, factories. Each firm can own one or more factories. In each factory n tasks ($n \geq 2$) are done, each task being done by one worker. Denote a worker's skill by q where $0 \leq q \leq 1$. We can interpret q as the probability that the worker finishes his or her task successfully. Let q_i be the skill-level that goes into task i, that is, the worker employed on task i has a skill level q_i and let B be the output produced per worker in a factory when all tasks are performed successfully. The ‘production function' in which x denotes the expected output is as follows:

$$x = q_1 \dots q_n nB \equiv \prod_{i=1}^{n} q_i nB \qquad [1]$$

It is easy to see that if all tasks are performed at skill level 1, then total output from the factory will be nB and so the per worker output is B.

To start with, let us take the skill levels of workers to be exogenously given. The decision-making by the firms can be modeled in two different ways. The traditional route is to assume that there are many price-taking firms and free entry. Since there is a continuum of worker types, there is a continuum of wages, one for each type of worker. Let w(q) be the market wage schedule exogenously given to the firms. We will throughout take the price of the product to be one. In this case the firm's problem is to choose n workers for operating a factory so as to maximize its profit. Hence, the firm's problem is the following:

$$\max_{\{q_i\}} [\prod_{i=1}^{n} q_i nB - \sum_{i=1}^{n} w(q_i)]$$

This gives us the following first-order condition for each task i:

$$w'(q_i^*) = \prod_{j \neq n} q_j^* nB \qquad [2]$$

In addition, Kremer (1993) proved that it is always in the firm's interest to have all its tasks done by workers of the same skill level. This is called the "skill-clustering theorem" in Basu (1997), where a short proof is available.

Theorem 1 (Skill-Clustering) *If* $(q_1^* \dots q_n^*)$ *maximize a firm's profit, then (in addition to equation [2])* $q_1^* = \cdots = q_n^*$

In light of the skill-clustering theorem, equation [2] can be written as

$$w'(q) = q^{n-1} nB,$$

where q is the skill of labor chosen for each task by a firm.

Since, in equilibrium, each firm earns zero profit, a firm employing workers of skill q must satisfy

$$q^n nB - nw(q) = 0$$

$$\text{or, } w(q) = q^n B. \qquad [3]$$

Hence, we know that in equilibrium the wage schedule for different worker qualities will be given by this equation.

An alternative approach, which however will not be pursued here, is to assume that there are two or more firms and these are Bertrand oligopsonists. Each firm announces the wage it is willing to pay for each type of worker, and workers go to the firm offering the highest wage, ties being broken arbitrarily. The `equilibrium' of this oligopsony is simply the Nash equilibrium of the normal-form game among the firms. As we know from standard oligopsony, in equilibrium each firm will earn zero profit. The logic of this is obvious. If there is a firm that earns positive profit, then another firm could offer its workers a slightly higher wage and woe them away. So the initial outcome would not have been a Nash equilibrium. If, in addition, we assume away the integer problem, that is, assume that, for each wage announced by the firm, either no worker will agree to work or any number of workers will, then the wage schedule in equilibrium will be exactly as shown by the above equation [3]

We shall however go with the traditional approach of taking this to be a model of perfectly competitive firms with free entry.

Endogenizing Level of Education

Let us now allow for the possibility that individuals do not come with an immutable skill level but can acquire skill through education. To make it possible to conduct a formal analysis, we have to take a slightly novel route in developing the idea of an equilibrium. We shall assume that there are two-periods. In the first, workers choose their level of education and in the second period, with education as

given, firms make their decisions as in a standard competitive model with free entry, in other words, exactly as described in the above section. In the first period, the workers essentially do a Nash-type calculation. That is, each worker calculates what would happen if he or she deviated and chose some other level of education. If she could not do better by any such deviation, then the existing choice of education for all workers is an `equilibrium'.

Formally, in the first period, each worker chooses to obtain a certain level of skill q through education. We will assume that the cost of education that provides the level of skill q is given by c(q) with $c'(q) \geq 0$. In the second period, the firms take their decisions about what kinds of workers to hire for the different tasks, with wages being treated as exogenous by each firm. The second period equilibrium is reached when we find a wage schedule (that is, a wage of each level of skill) such that each firm maximizes profits and earns zero. In other words, the second period works as described in the previous section. After the second period, firms earn their payoffs (we already know this will be zero in equilibrium) and each worker receives his or her payoff, which is equal to the wage earned by the worker minus the cost of education.

In defining the equilibrium formally in this two-period model, let us focus on a refinement of what was described informally above. The refinement is an outcome in which all workers voluntarily choose the same level of skill. We shall call this the `symmetric equilibrium', with the frequent indulgence of dropping the epithet `symmetric', since we are not going to talk about a non-symmetric equilibrium in this paper.

A skill level q and a wage equal to $q^n B$ for each of these workers is a (symmetric) equilibrium if and only if

1. $q^n B \geq c(q)$ and

2. for all $\hat{q}$, the wage that a worker who individually deviates to $\hat{q}$ earns is such that wage minus the cost of that education, namely, c($\hat{q}$), is less than or equal to q^nB-c(q).

In other words, all workers earn enough to cover their education cost and no worker by unilaterally deviating to some other level of education can do better.

To formalize condition (2), we need to describe what the wage a worker who unilaterally deviates to q when everybody else has chosen q, will earn. With a slight abuse of notation, denote this wage by $w(\hat{q};q)$and denote the profit of the firm hiring this person by$\pi(\hat{q};q)$. Clearly,

$$\pi(\hat{q};q) = \hat{q}q^{n-1}nB - (n-1)w(q) - w(\hat{q};q)$$
$$= \hat{q}q^{n-1}nB - (n-1)q^nB - w(\hat{q};q).$$

The firm will hire this worker if and only if

$$\pi(\hat{q};q) \geq \pi(q) = 0.$$

Therefore, $w(\hat{q};q)$ is the maximum possible wage the worker can get while ensuring that the above inequality is satisfied. Otherwise the firm will refuse to employ this worker. It is now easy to derive that when all other workers have skill q, the wage of a worker with skill $\hat{q}$ will be given by:

$$w(\hat{q};q) = \hat{q}q^{n-1}nB - (n-1)q^nB \qquad [4]$$

What is interesting and makes our analysis easy to conduct is a property of w(q;q). The property is the following. The graph of $w(\hat{q};q)$as q changes is always given by the straight line that is tangent to w(q) (=q^nB) at q.

What we are now ready to demonstrate is that this model can have multiple symmetric equilibria. In other words, it is possible to have a very low level of education which is an equilibrium in the sense that if everybody chooses it, nobody can do better by deviating, and there is also a possibility of a very high level of education in equilibrium. A society can simply get caught in a low literacy trap. Between two societies, one highly skilled and another with rudimentary skills there

may be no fundamental difference. They can be mere victims of their history. Using the property of w($\hat{q}$;q) mentioned above, these results are easy to prove. This can be done with a few simple examples; and that is what we do presently. The last section of the paper goes into the large policy implications for what the government could do to promote education and the acquisition of human capital and skills.

Linear Cost Function and Literacy Trap

Consider a linear cost function for education as follows. Individuals are born with some level of skill, say z. Alternatively, this is a level of skill that comes to us costlessly. Most human beings can perform basic tasks without having to undergo any formal training. To acquire skill beyond z, a worker has to incur a cost, which increases linearly with the level of skill. To sum up, the cost of education for attaining skill q is given by:

$$c(q) = \begin{cases} 0, \ for\ 0 \le q \le z \\ a(q-z), for\ \ z < q \le 1 \end{cases} \quad [5]$$

where a is such that

$$z^{n-1} < \frac{a}{nB} < 1 \ and \ (\frac{nz}{n-1})^{n-1} \ge \frac{a}{nB} \quad [6]$$

The first assumption guarantees that the cost of education is neither very high so that no one chooses to get more skill than z, nor very low so that everyone chooses to become an expert. The second assumption guarantees that c(q)≤w(q) for all q∈[0,1].

Define q such that

$$w'(\bar{q}) = a$$

or,

$$\bar{q} = (\frac{a}{nB})^{\frac{1}{n-1}}$$

q is illustrated in Figure [3.1].

Claim 1 *Every worker acquiring skill $\bar{q}$ and earning a wage of $\bar{q}^n B$ is an equilibrium.*

Proof. Suppose all workers have chosen $\bar{q}$. We know that perfect competition among firms with free entry will drive wages to $\bar{q}^n$B. It has already been seen earlier

that firms offer the wage structure w(.;.) given by [4] optimally and none of the firms deviate from offering this.

Let us now check how a worker, who unilaterally deviates from q will do. Note that by assumption [6], $w(\bar{q})\geq c(\bar{q})$ and $z<\bar{q}<1$. Now, from [4], we have

$$\frac{\partial w(q;\bar{q})}{\partial q} = \bar{q}^{n-1}nB = w'(\bar{q}) = a.$$

This implies that $w(q;\bar{q})$ is parallel to c(q) for all $q\in[z,1]$. This in turn means that

$$w(q;\bar{q}) - c(\bar{q}) = w(q;\bar{q}) - c(q)\ for\ all\ q \in [z,1].$$

But, $w(q;\bar{q}) = w(q)$. Therefore,

$$w(\bar{q}) - c(\bar{q}) \geq w(q;\bar{q}) - c(q)\ for\ all\ q \in [0,1].$$

Hence, $\bar{q}$ is an equilibrium. It is interesting to note that deviations to the interval [z,1] leave the deviating worker exactly as well off as before, and all other deviations make the worker worse off. ■

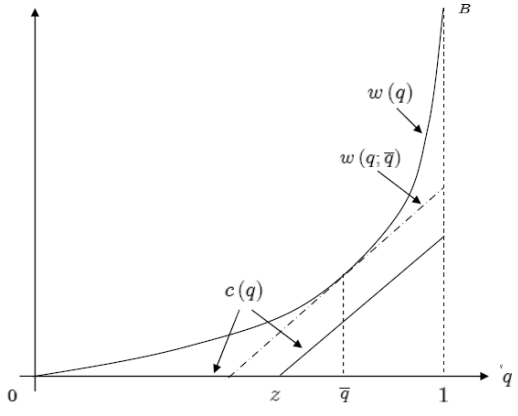

Figure 3-A

Claim 2 *In this example, with linear cost function given by [5], there are two other equilibria, one in which all workers choose $q_*=z$ and another in which all workers choose $q^*=1$.*

Proof. First, suppose all workers choose $q^*=1$ and one of them contemplates deviating from this common choice to a lower level of quality $\hat{q}<1$. Again the tangent line to the graph of w(q) at $q^*=1$ gives the wage for obtaining quality $\hat{q}$. Now, for all $\hat{q}<q^*$, the following is true:

$$\frac{\partial w(\hat{q};q^*)}{\partial \hat{q}} > w'(q^*) = a.$$

The inequality holds because w(q) is a convex function and $q^*=1>\bar{q}$. Therefore, the loss in wages due to deviation to $\hat{q}$ from q^* more than offsets the cost savings since $w(\hat{q};q^*)$ is more steeply sloped than the cost function. Thus deviation would lead to a lower payoff.

Similarly, if all workers choose $q_*=z$, then deviation to $\hat{q}>z$ is not advantageous since $q_*=z<\bar{q}$ implies that

$$\frac{\partial w(\hat{q};q_*)}{\partial \hat{q}} = w'(q_*) < w'(\bar{q}) = a.$$

Finally, deviation to $\hat{q}<z$ lowers wages without reducing costs, so workers won't do that.

It is easy to see that there does not exist any other equilibrium apart from the three described above in this model with the linear cost function given by [5].

Literacy Trap and Big Push

Note that, while $\bar{q}$ is an equilibrium, it is not `stable' in the following sense. In a society where all the workers are skilled upto level $\bar{q}$, if it is possible to increase everyone's skill a little bit, then each of the workers will deviate further *away* from $\bar{q}$. That is, they will increase their skill; and note that this dynamic will continue till the equilibrium q^* is reached or gradually approached. On the other hand, if everybody's skill was lowered a little, then a downward dynamic would start up and society could go all the way to the equilibrium q_*.

Finally, we have a big `literacy trap' at the education-level which provides skill $q_*$=z. A `big push' that drives the entire economy beyond the skill-level $\bar{q}$ can start up innate forces that will then take the economy all the way to the good equilibrium. All smaller efforts will keep pulling workers back to q_*=z. This has one heartening implication. In an economy with widespread illiteracy, the cost of raising human capital may not be as much as appears at first sight. This is because the funding needed to promote education will not have to be sustained endlessly through time. As soon as a threshold is crossed, the accumulation of human capital and skills can be left to natural forces and will continue unabated.

More General Cost Function and Literacy Trap

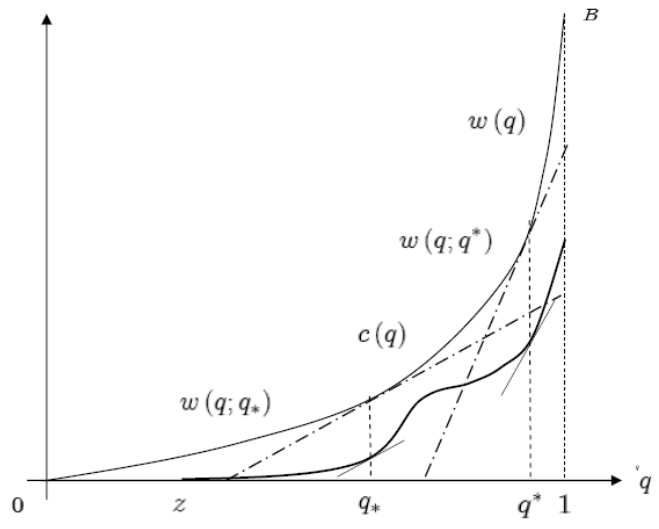

Figure 3-B

Though we illustrated our main results with the linear case, there is no need to confine the analysis to such cases. Virtually all results carry over to the more general, nonlinear cases. Consider the non-linear cost function as shown in Figure 3-B. As in

case of linear cost function, suppose primary education that provides skill z is free. Then the cost of education increases at an increasing rate. After some point, the behavior of the cost function changes and as someone gets more educated, the less is his marginal cost of education. After a very high level of education, the marginal cost starts increasing again.

It is clear from the largely self-explanatory figure above that even with non-linear cost of education we may have multiple equilibria. In this particular example, we have two symmetric and strict Nash equilibria. As shown in Figure 3-b, q_*.and q^* with firms offering wages w(.) given by [3] are the two Nash equilibria and both are stable. Thus a literacy trap may occur in a society where all the workers optimally choose to attain the skill q_*.

Policy Interventions

Increasing literacy and the advancement of human capital has been a major focus of policy-making certainly in developing countries but also in developed nations. Evidently, there are two sides to this policy. There has to be a demand for education on the part of parents taking decisions for their children and young adults taking decisions for their own education. Secondly, there has to be a supply of schools so that parents who wish to educate their children can do so. In popular discourse, it is often said that poor parents do not want to educate their children. This has met, rightly, with strong criticism (see PROBE Team, 1999). However, this must not blind us to the fact that the intensity of demand for education can vary and this can make a difference to the literacy outcome of a nation (see PROBE Team, 1999; Drèze and Kingdon, 2001). It is believed that the rewards from education -- the so-called `skill premium' -- have been rising in the developing world; and there is now some hard evidence on this (see Arbache, Dickerson and Green, 2004; Azam, 2009). When this happens, it is not surprising to find that the demand for getting education will also become stronger. It is

now said in India, given that missionary schools had historically played a major role in the country, that all you have to do is to think of a good English name, like John or Thomas or Mary and add the prefix "Saint" and suffix "School" to it; and you will be in the education business with students flocking to you.

In our model, it is easy to see that the same country where the demand for education is low because the skill premium is low can change to an equilibrium with high premium and high demand for education. In Figure 3-A, if we start from a case where the country is caught at a low literacy trap at z, it is not worthwhile for any individual to seek more education. The skill premium is just not high enough to make this worthwhile. If, on the other hand, education rises and goes past $\bar{q}$ for everybody, then people will invest even more in education and the nation will come to rest at a very high level of education for all.

Our model allows us to separate out the demand and supply aspects quite neatly and so enables us to take a more sophisticated view on policy. We can think of government-subsidized education as an intervention which lowers the cost of education. This can have interesting effects depending on how it is done. Suppose government gives a small flat subsidy s for all levels of education. Contrary to what is presumed, this may have no effect on education. This will be true for all the equilibria depicted in Figures 3-A and 3-B, excepting at z in Figure 3-A. To boost education, government has to vary the subsidy with respect to the level of education. In other words, the government needs to have a non-constant function s(q). The total cost of education is then given by [c(q)-s(q)]. By suitably altering the slope of s(q), the state can boost education. Indeed the net expenditure on education could be very small if the subsidy function is chosen artfully. If the economy is caught at equilibrium z in Figure 3-A, then a constant small subsidy will have a small positive effect on education. Beyond a critical point, it will have a huge effect, pushing skill acquisition

all the way to the maximum value 1, with no need for any subsidy in the new equilibrium.

The model suggests that the fiscal burden of boosting education may not be too high, because all we need is a short period boost, after which the natural incentives in the system kick in and little further outside intervention is needed. For this same reason, it may be worthwhile for a country caught in a low-literacy equilibrium to have a policy of compulsory education, which forces parents to educate their children. If this can be sustained for a while, the need for force will vanish since the high education of the rest of the population will raise the education premium for each individual.

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Chapter 4

A Note on Product Boycotts

Introduction

Child labor persists in developing countries. Unable to fathom that poverty and a lack of outside opportunities is the primary cause of families sending their children to work, many consumers in rich nations use product boycotts to reduce the incidences of child labor. Although they may be full of good intentions, there is a large body of evidence showing that such consumer activism can be counter-productive. In particular, Basu and Zarghamee (2009) show that boycotting products made from child labor can lead to a decline in the child's wage rate. Assuming that children work to cover a subsistence need of the family a decreased wage leads to an increase in child labor. They call this paradoxical result the 'backlash proposition'.

The theoretical arguments demonstrating the tenacity of child labor in the midst of poverty have been well documented. Not as strong as the backlash proposition, Edmonds (2003) suggest that children would be hurt by sanctions if alternative activities were not provided and Baland and Duprez (2007) find that child labor labels can hurt the welfare of nations where child labor exist. But why then is consumer activism against child labor so strong? Theories that suggest that child labor standards are supported by firms purely from profit motives (see Davies, 2005) cannot explain the actions of consumers in rich countries willing to pay a premium for untarnished goods.

In this note the Basu and Zarghamee (2009) model is slightly extended so that the product boycotts effect on a good's price level varies with the amount of children working in the industry. The result is a weakening of their backlash proposition. Due to a type of multiple equilibria different from those described by Basu and Van (1998),

the model's predictions for the impact of consumer activism on child welfare depends on the economy's initial equilibrium. The ambiguous nature of the impact of consumer activism provides an explanation for why an altruistic consumer might continue to engage in activism against child labor in spite of the previous research highlighting its potential for negative welfare effects.

The note will first present the basic model and an explanation of the endogenous price, then an example with a linear production and close with a discussion.

Basic Model-Endogenous Price Level

The model presented in this note follows Basu and Zarghamee (2009) except that it allows the impact of consumer activism on the relative price of tainted goods to vary with the amount of children engaged in the production process. Consider the market for hand woven rugs. Rugs that have been produced without child labor can be purchased for price p. Then rugs that use child labor in the production process can be purchased for α p where $\alpha<1$ when there is a preference for non-tainted rugs. Formally α is derived from utility maximizing behavior of consumers and $\alpha \in [0,1]$. If $\alpha=1$ there is no boycott, the method of consumer activism, and if $\alpha=0$ there is a complete ban.

In order to allow the effect of consumer activism on prices to depend on the amount of child labor in the production process assume that $\alpha=\alpha(c)$, where c is the aggregate level of child labor used in the rug industry. One justification for this assumption is that consumers distaste for tainted goods is increasing in the number of children engaged in the industry. A television ad saying "10 children in Bangladesh make rugs instead of attending school" is less provocative than one that replaces 10 with 100,000. As such, the impact on consumers shopping habits stands to be less. If

shoppers do not change their habits then there would be little difference in the relative price of the two goods even though consumers have the same distaste for child labor.

A related reason for $\alpha=\alpha(c)$ is the benefit to checking for rugs made with child labor. When only a small share of the rug industry is made from child labor the cost to detection could easily outweigh its benefits. In this case factories employing child labor could easily be sold undetected resulting in a relative price level close to one. As the number of child labor increases the benefit to inspecting starts to outweigh its cost and the relative price level begins to decrease.

In both of these cases a given level of consumer activism has a greater impact on the rug industry and consumer behavior as the aggregate level of child labor increases. As a result $\alpha'(c)<0$[5]. No further assumptions are made on $\alpha(c)$. The result is a weakened backlash proposition and an example of consumer activism increasing child welfare in the case of a linear production function.

Labor Market

Turning to the labor market--there are N worker households each with one adult and m children. It is assumed that adults supply their labor inelastically. There is a subsistence level of consumption, s, that much be reached for the household to have a positive utility. After reaching s the household only cares about the child's leisure, r. Consistent with the luxury axiom proposed by Basu and Van (2009), the sole purpose of child labor is to secure a minimum income. Thus children only work to make up for the adults inability to secure s. This provides for the backward bending labor supply curve found in Basu and Zarghamee (2009) and here. Here is a simple representation of these household preferences:

[5] In many cases the monotonicity assumption made here would be inappropriate. In the examples presented here the goods are being produced for the export market. Otherwise, local norms become more important and information becomes less information resulting in $\alpha'(c)>0$. The first family to send the children to work might face great scorn and receive little pay but that scorn decreases if all families do it.

$$U(x, r) = \begin{cases} x - s, & x < 0 \\ r, & x \geq s \end{cases}$$

Following Basu and Zarghamee (2009) w_A the worker household's labor supply in adult units is given by:

$$l(w_A, w_c) = \begin{cases} 1 + \gamma * \min\{m, \frac{s - w_A}{w_C}\}, & w_A \leq 0 \; or \; w_C \geq 0 \\ 1, & w_A \geq s \end{cases}$$

With N identical households the aggregate labor supply is N*$l(w_A, w_C)$ where w_A is the adult wage and w_C is the child wage. The one adult supply's her labor inelastically. If her wage is high enough to cover subsistence then children do not work. Also, if children are not paid a positive wage they do not work. If, however, adult labor does not cover subsistence and child wages are positive then the children work to cover the shortfall in household income. The child labor is converted to its adult equivalent by multiplying it by γ.

Now the firm's problem and the separation result can be established. The separation result is that firms hire either adults, or children, but not both. Firms employ labor as the only input. If X is the amount of output and L is the amount of adult equivalent units of labor then X=F(L) and L=A+γC where A is the amount of adult labor and C is the amount of child labor employed by the firm. Later it will be assumed that the production function is linear in labor but for the purpose of the `separation result' only F(0)=0,F'(L)>0, and F''(L)≦0 is required.

The profit, Π, earned by a firm is given by:

$$\Pi(A, C) = \begin{cases} F(A) - w_A A, & C = 0 \\ \alpha F(A + \gamma C) - w_A A - w_C C, & C > 0 \end{cases}$$

Lemma: Let A and C denote the number of adults and children, respectively, hired by a firm. Given α<1, there will exist no firm such that C>0 and A>0.

Proof: A profit maximizing firm chooses the inputs that give the highest marginal product per dollar spent. Suppose a firm hires A*>0 adults and C*>0 children. It must be the case that $\gamma w_A = w_C$. Define $A = A^* + \gamma C^*$. It is shown below, a firm employing A adults and zero children would have greater profits than one that employs a positive amounts of both adults and children.

$$\Pi(A, C) = \begin{cases} F(A) - w_A A, & C = 0 \\ \alpha F(A + \gamma C) - w_A A - w_C C, & C > 0 \end{cases}$$

$$\Pi(A^*, C^*) = \alpha F(A^* + \gamma C^*) - w_A A^* - w_c C^*$$

$$= \alpha F(A^* + \gamma C^*) - w_A (A^* - \gamma C^*)$$

$$< F(A^* + \gamma C^*) - w_A (A^* - \gamma C^*)$$

$$= \Pi(\widehat{A}, 0)$$

As a result, no firm employs both child and adult labor.

Linear Production

In the linear case F(L)=bL. The focus is on child labor so assume b<s. Substituting $\alpha\gamma w_A$ for w_C the aggregate labor supply can be written as a function of w_A, $l(w_A)=N(1+\gamma\min\{m,((s-w_A)/(\alpha\gamma w_A))\})$. The relationship between the amount of child labor provided by the household and the amount of consumer activism is given by, $c(w_A,\alpha)=\gamma\min\{m,((s-w_A)/(\alpha\gamma w_A))\}$. As children work for the purpose of satisfying a basic need, increases in consumer activism, modeled as shifts down in α(c), decrease the wages paid to children and increase the amount of work that they supply until all their labor is exhausted. As the production function is linear the demand for labor is flat and any increase in supply corresponds to an increase in the equilibrium amount of child labor. Figure 3-A shows how this results in the strong backlash proposition of Basu and Zarghamee (2009). An increase in consumer activism implies lower prices for the boycott product leading to lower child wages. As children work to meet

minimum consumption requirements, the luxury axiom, lower wages immediately imply higher child employment unless the economy began at a boundary where no more child labor could be supplied. The result is that when the production function is linear consumer activism has either a neutral or negative impact on the amount of children employed and always has a negative impact on child welfare.

When the relative prices are allowed to vary, a shift down in the α(c) curve due an increase in consumer activism can have a positive impact on child employment and child welfare (see Figure 3-B). With a linear production function labor markets always clear when $w_C=\alpha\gamma w_A$. Equilibrium requires the expected price ratio to be fulfilled. This implies $\alpha=\alpha(c(w_A,\alpha))$. Figure 3-B shows that there are two points that satisfy this condition, each with different levels of child labor and different price levels for a given amount of activism. Figure 3-B demonstrates that depending on the initial condition an increase in consumer activism can have beneficial effects on the amount of child labor, and child welfare. The backlash proposition of Basu and Zarghamee (2009) has been weakened and the ambiguity of consumer activism in the child labor debate is further highlighted.

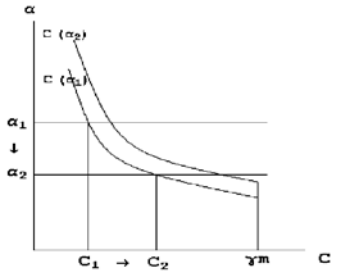

Figure 4-A

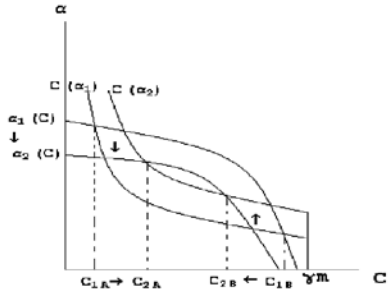

Figure 4-B

Conclusion

On neither side of the child labor debate is there a clear cut, and simple solution to increasing the welfare of the worlds vulnerable, poor and young. Education is essential, but so is food and consumer activism can be a heavy and misguided hand. So too is advice that says nothing can be done by individuals in rich countries. Economists have made a point to show the problems of labor standards and consumer activism, this note shows even the ambiguity in those results. There are cases when activism may help. Given that, it is important to understand empirically when the economy is at a point where activism might succeed in increasing child welfare and decrease child labor.

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